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Real Service Must Be Engineered

Many of the men whose names are writ large in engineering history are design engineers; men like Westinghouse, Lamme, Stanley, Hodgkinson, Tesla, Shallenberger. Their inventions have the quality of usefulness, of reliability, of productability; which is an involved way, perhaps, of saying that they have the primary requisite of all really great inventions: *Serviceability.*

Engineering history abounds in instances of near-genius that produced no product, and of great developments that never reached completion; and most of these instances are explained by the lack, somewhere in the system, of that ability to give real Service.

Service, in a machine or a system, or wherever you find it, is not there by accident but because it was incorporated by men who understood what was required and knew how to provide it.

Much more is required of the designer than facility in calculation and mastery of theory. He must have first hand and thorough familiarity with manufacturing operations and with commercial and operating conditions. It takes more than mere ingenuity and inventiveness to design apparatus that will be really serviceable and will "stay put."

The design engineer, in the Westinghouse plan, is responsible for the performance of the finished product. He cannot possibly have the proper understanding of operation unless he operates and tests, unless he spends time and thought in investigation and study, not in the laboratory or drawing room, but right on the operating job. Here, most of his ideas will develop; and here he will see and prepare for all the different things which the product will later have to encounter. Then when he comes to put his creations on paper, his calculations will be necessary and helpful to check the conclusions which he has reached, and this right use of them requires training and a high degree of understanding. This proper balance of the physical and mathematical conception of things is what constitutes engineering judgement.

It should be thoroughly understood that the primary function of the design engineer is the conception and the production of new or improved apparatus, and familiarity with the practical is essential to the proper discharge of this duty.

It is this view of designing that makes this branch of Westinghouse engineering so important, so effective, and so productive of real developments.

W WESTINGHOUSE ELECTRIC

Westinghouse

ACHIEVEMENT & OPPORTUNITY

THE
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Franklin Field—1922

THE TOWNE SCIENTIFIC SCHOOL JOURNAL

Keep Going

WE HAVE all read and heard of those men and horses who get away to a good start and leave the rest at the crack of the gun and get such a lead that they cannot be caught. He too has been heralded, who is a strong finisher and who has a sprint at the end to overtake the pack on the home-stretch and break the tape a winner. It is our contention, however, that it is hard to beat a horse who runs fast all the way. A good start may help in a sprint race and a good sprint at the finish may win for middle distances; but for a distance race the one who plugs away and keeps going at full speed from start to finish is the one that we bet our meagre roll on.

In the classroom the conditions are unchanged. Here as on the cinders the man who can run fast all the way comes in the winner, for this is a distance race; make no mistake about that. We have seen sprinters drop out of the race because they depended alone on their good start. Also those strong finishers have fallen by the wayside, having found themselves so far back near the finish that their final spurt was not enough to carry them to the front; or they have been put off the track before they have time to start their sprint. So if you are depending on a good start or a strong finish to win in this race, our advice is to stop now and change your style of racing. If you give your best from start to finish the spoils of victory will be yours.

The Lost Half Hour

THE new schedule of 9 o'clock classes has been in effect several weeks now, and already upper class-men are sighing for the return of the lost half hour recess. The freshmen, unaware that it ever existed, are happier in their ignorance. To the College or Wharton man, with his comparatively light roster, the change may be a benefit, in that it condenses his three or four daily classes a bit, and the wait between recitations is not quite so long.

The Engineer does not complain. He does not point out that in the majority of rosters it means continuous classes from 9 to 1 for him. And after these is chapel to give the finishing touch to his appetite. No, the Engineer has long since become inured to lengthy rosters. He has borne them without a murmur; he has even bragged about them to the less fortunate Wharton man.

We did not object to 8.30 classes; they were not too early. Many an Engineer finds it difficult to slumber for an extra half hour in the morning, so used to them had we become. There is no advantage for us.

On the contrary the 10.30 recess was our social hour. In the second floor smoking room the students gathered to discuss studies, university politics, to exchange cheery greetings, to brush up for the next two recitations, to hold committee meetings. It was really a scene peculiar to Towne, and it was worth while and stimulating. There, if any place, was the chance to meet one's fellow students. Now the fraternity houses and lunch counters claim us from 1 to 2, and Room 213 is forlorn and deserted, without its haze of tobacco smoke and its hum of voices.

It would be asking much to have the 10.30 recess restored, we know. But, oh how we miss it!

Welcome! Freshmen

IT HAS become quite a regular thing at the University that a certain number of freshmen appear on the campus each September. The regularity of this event is only equalled by that occasion when the time-honored and unchanging advice for the furtherance of their college career is ladled out to them. It is therefore somewhat of a difficult thing to write a greeting to our new arrivals without becoming either trite or boring or both.

I am fortunate, however, in speaking only to the Engineering freshmen. For some years now we have been making a determined effort for greater unity within the walls of the Engineering Building. We know that our school is by far the best equipped, the most productive of mental effort, and contains the best men. But it is only by backing the Engineering School activities to the limit and making for each one the success that it deserves that we can prove these things to the University at large.

You came here to become engineers. Ask Professor Fernald how much it matters whether you are studying Civil, Electrical or any specialized field. At a recent meeting of the Mechanical Engineering Alumni of M. I. T. the speaker of the day was a one year architect, the master of ceremonies had studied chemistry for three years and the host had graduated rather sooner than he wished. There is no telling what branch of work you will follow after graduation. You desire to become that most efficient and adaptable specimen of humanity known as an Engineer. Can you not see, then, the great benefit of associating with your fellow students in activities which follow engineering lines?

There is no need to mention studies here. You'll work or get out, as you'll discover very soon. The faculty attends to that. But it might be a good idea to remind you men of '26 that two years from next spring there will be a meeting in Weightman Hall at which the honor men of your class will be announced. It is entirely in your hands whether you will know the blush of proud embarrassment, or applaud your friends.

In closing I should like to say that now that you have accepted this opportunity for higher education, your future success or failure depends solely upon yourselves. You will owe this success largely to your University. Is it not reasonable, in view of this, that from this time forth you should leave no stone unturned to aid your Alma Mater?

WALTER P. MILLER, JR.,
President Engineering Association.

The Varsity "P"

THE biggest honor that a man can win at Pennsylvania is the right to wear his 'Varsity "P". It means that he has fought hard, it means that he has worked consistently, it means that he has kept faith with himself and with his coaches until he has reached the point where he is worthy to stand as a representative of this University against the best that other colleges can produce. The man who wins his letter on the football field, on the track, on the river—on any of our major sport teams, in fact—is worthy of this honor, for he has given his best for Pennsylvania. But there is another group of athletes who work just as hard and fight just as determinedly for their University, who go almost unrecognized. These are the members of the minor sport teams.

As things are now, a minor sport "P" means more than a major letter, which is eminently unfair. Only the holders of Intercollegiate Championships are eligible for minor sport letters, while the major sport teams receive their "P's" whether they are victorious or not. It seems unjust that only such insignia as the sPT, wPT, and wPP of the swimming, wrestling and water po'o teams should be given to those men who have proven their loyalty to Pennsylvania by passing through just as severe a test as the members of any major sport team.

It would not be lowering the standard of the "P" to award 'Varsity letters to the members of every team representing the University. There would still be the distinction between the major sport and minor sport letters and the major sport teams would still rank highest in the popular regard. But, if the candidate for every team were given an equal chance to win his letter, there would be a higher standard of athletics at Pennsylvania. Competition would be keener and more and better men would work for the honor to be gained. Our University would stand at the top in every line of sport.

Any man who is worthy to represent Pennsylvania is worthy of his 'Varsity "P".

CLARENCE EDWARD CLEWELL was born in in Ohio on July 3, 1883, his parents moving to North Carolina in 1884. He received his primary and high school education in the schools of Salem, North Carolina, coming north in 1899 to serve an apprenticeship successively in the plant of the Bethlehem, Pa., Electric Light Company, in the survey for the Slate Belt Electric Railway Company through the slate regions of Pennsylvania, and in electric wiring work for a local Bethlehem contractor and later for the Fries Manufacturing and Power Company in Winston-Salem, North Carolina. Two years of practical experience were thus gained between his high school and university courses.

He graduated from Lehigh University in 1905 with the degree of Electrical Engineer and after a short apprenticeship course at the East Pittsburgh works of the Westinghouse Electric and Manufacturing Company, he served for four years as instructor in Electrical Engineering at Lehigh. The following three years were spent at the Westinghouse plant at East Pittsburgh during which he planned out new lighting systems for a large portion of that fifty-seven-acre works. In 1912 he became instructor in Electrical Engineering at the Sheffield Scientific School of Yale University and in 1914 was appointed Assistant Professor of Electrical Engineering at the University of Pennsylvania, in 1920 became full Professor of Electrical Engineering and on June 1, 1922, was appointed Dean pro tempore for the year and a quarter during Dean Frazer's absence in France as Exchange Professor.

Dean Clewell has been much interested in electric lighting work, having made a full report on the lighting system of the B. F. Goodrich Rubber Company's plant at Akron, Ohio, and having designed, among others, lighting systems for the Federal Reserve Bank building of Philadelphia, the Museum of Safety of the State Labor Department at Jersey City, New Jersey, the Newark, N. J., works of the Westinghouse Electric and Manufacturing Company, and for the past three years has been engaged in a complete redesign of the street lighting system in the City of Trenton, N. J.

He is a member of the Lehigh Chapter of Tau Beta Pi, of the University of Pennsylvania Chapters of Eta Kappa Nu and Sigma Tau, of the Yale Chapter of Sigma Xi, of the Berzelius Society of Yale, and of the Sigma Chi Fraternity.

GREETING FOR THE NEW UNIVERSITY YEAR

I HAVE been asked by the Editors to say a word in this first issue of the TOWNE SCIENTIFIC SCHOOL JOURNAL by way of greeting for the new University year. I have, as you know, assumed a task of considerable responsibility for the year and a quarter during Dean Frazer's absence on his notable mission to France. It is my earnest hope that I may, with your co-operation, administer the affairs of the Towne Scientific School in such a way as to be able to return the office to Dean Frazer in September, 1923, at the same point of high efficiency that it had when he turned it over to me last June.

While my tenure of office is thus necessarily temporary in character, we should all keep in mind that a year is just that much in the history of this venerable and honored institution. Surely we all want a greater and better Pennsylvania with each succeeding year and we should, I think, most earnestly look for a steady deepening of those traditional factors which weigh so heavily with all that the words *greater* and *better* are intended to include.

If I may venture one thought perhaps more than others it would be to propose that as faculty, alumni and undergraduates, we all combine into one united effort for making doubly sure that we shall be guided by a true spirit of loyalty over against the future of the University of Pennsylvania, for without it, our best efforts may become ineffective, but with it, the accomplishment of even the seemingly impossible can be rendered sure.

The Concrete Horse-shoe

C. C. Roth, '23

ON 34th Street, directly behind Weightman Hall, hidden from the view of all, except those interested in athletics, stands a colossal monument to modern engineering. A structure capable of seating over 50,000 people, yet so arranged and constructed that this immense crowd can be both easily and safely handled. By building this huge stadium Penn has answered the call of years for larger and more adequate stands to seat the crowds attending the football games, relay carnivals and intercollegiate track and field meets.

The construction of the stadium can, for convenience, be divided into three separate phases, although all are closely connected. The foundation work, the erection of the stands themselves, and the facing or beautifying of the structure are the three distinct operations arranged in time order. Of necessity, the old stands were completely destroyed before any work could be started on the new stands, and this first process appeared to progress slowly due to the fact that it consisted primarily of engineering layout and the driving of piles.

The deck or stands rest upon rows of columns, five deep under the north and south sections and six deep under the east section. These columns, in turn, rest upon concrete piles each capable of taking a load of 35,000 pounds. The outer frames of the piles, made of tin, were driven to a penetration of not more than three inches in twelve blows. The core then collapsed leaving a hollow, tin, tapering shaft; this was filled with concrete, reinforcing being omitted as the surrounding ground was considered solid enough to take any lateral stress. The number of piles under single columns varies as the load increases from the inside of the stands to the outside. The number varies from single piles to twelve piles under a single footing. The top of the piles project six inches into a 30-inch cap of solid concrete. Bond steel, projected from the piles into the cap, and horizontal steel, were placed in the caps to take care of tension in case a column rested upon more than one pile. The caps vary in size in accordance with number of piles and upon these blocks of concrete rest the columns which support the stands.

The columns, being poured separately from the caps, are held in place with bond steel projecting from the cap into the column. The columns themselves vary in size as the load increases from the inside of the stands to the outside and from the lower level up. The columns are reinforced with deformed steel tied in with hopps. The fire proofing is assured by means of cement "dough nuts" which hold the reinforced in place. The forms for the column consist of heavy lumber tied together with 4x4-inch timbers, these in turn being held together by steel rods. Much care had to be exercised in pouring columns due to the excess lateral stress created by settling concrete. The largest columns were poured in sections to guard against any bulging effect.

After about ten days to two weeks these forms could be removed and after careful cleaning and oiling used again. The columns were tied with the deck itself by means of bent steel bars imbedded in the columns.

The deck, which actually holds the seats, consists of 4-inch slabs or treads and 4-inch risers, both being reinforced. The deck extends between girders connecting the columns and between beams connecting the girders at the columns. The deck then actually covers an area approximately 17 feet x 19 feet, these distances changing with the location of the columns. But as each riser is actually an individual beam four inches thick and from nine inches to fifteen inches deep, the slab to be carried by these beams would only be the tread distance between risers. So the strength of the deck itself, theoretically, is far in excess of the load to be placed upon it. The risers are all heavily reinforced with double bent steel and serve as actual beams. The treads all have a slope of ½ inch to ensure drainage. The actual construction of the form for the deck consisted of a lower box, to hold the inert concrete, in the shape of the deck itself; in front of these were hung face forms. To hold the concrete until it had gained sufficient strength to become self-supporting was a problem. It was solved by means of a dense shoring by 4x4-inch timbers. The deck was poured in sections, consisting of two panels, a panel being the distance between rows of columns and extending from the front to the rear of the stands. These pours, once started, were finished the same day and separate pours were held together by bond steel. With the exception of the north, east and southeast curb lines no allowance was made for expansion, but cold-water paint was applied on the intersecting face of separate pours to prevent a close bond and allow a slight slip. The

(*Continued on page 22*)

Increasing Power Station Efficiency by Using Distilled Water

ERNEST H. CHAPIN, '20

WHAT prevents a boiler from giving the most pounds of steam for a pound of coal? What keeps it from making a run of 300 per cent. of rating? These are vital questions in all power plants, large and small, in a more or less degree. As the size of the station increases, the relative importance of such points becomes the subject of careful investigation by the operating superintendent, and the design engineer. The modern central station, producing electrical energy from coal, and distributing this electricity over a large area, has been developed to a point of maximum economy, practically speaking, from the viewpoint of the turbine room. The boiler room, with its auxiliaries, is a field where the possibilities of cutting down the pounds of coal for a kilowatt produced, are yet to be developed to their fullest extent.

For the larger station in particular, any raw water, or natural water, is an imperfect water for the feeding of boilers. Scale forms on the boiler tubes, decreasing the efficiency of operation, and making shut-downs and cleaning necessary. Solids accumulate in the boiler, as sludge, or mud, and necessitate the blowing down of boilers, with the accompanying waste of heat. The solids held in solution also limit the overload capacity of the boiler, for after passing a certain limit, priming of the boilers occurs, and the superheaters, and even the turbine blading becomes fouled with mineral matter, carried over with the steam.

The use of a surface type condenser, where most of the steam produced in the boiler, and going to the turbine, is returned as condensed steam, is a great benefit in such a situation. Here, in an efficiently run plant, the losses of water, either in the form of steam leaks, or water leaks, from various places, will run less than five per cent. of the total boiler evaporation. This loss has to be made up by the introduction of water from the outside. If this water is "hard", or contains solids of any sort, it will gradually bring about the conditions in the boiler mentioned above. It must be either treated in some way, or purified so that this harmful effect is minimized.

Treating systems, regardless how efficient, produce a water which only to a more or less incomplete degree, gives a perfect boiler feed water. Some solids, either scale-forming, or not scale-forming, are left in the water, after treatment, so that if scale does not actually form in the boilers, boiler blow-down is still necessary, and boiler priming is a consideration.

So the perfect boiler feed should be one which eliminates all of these things. Distilled water is the one answer to all of these questions. Supplying the power station cycle with distilled water, to make up the water losses which occur, means that at all times the water going to, and the steam coming from the boilers is pure, and free from all contaminating foreign matter. No boiler blow-down is necessary, and the heat losses occurring by such blowing down are avoided. The boilers can be run at the highest possible overloads that the stokers and firebox can furnish, without priming. Corrosion is largely eliminated, and shutting down of boilers for cleaning, repairs, and general maintenance is minimized.

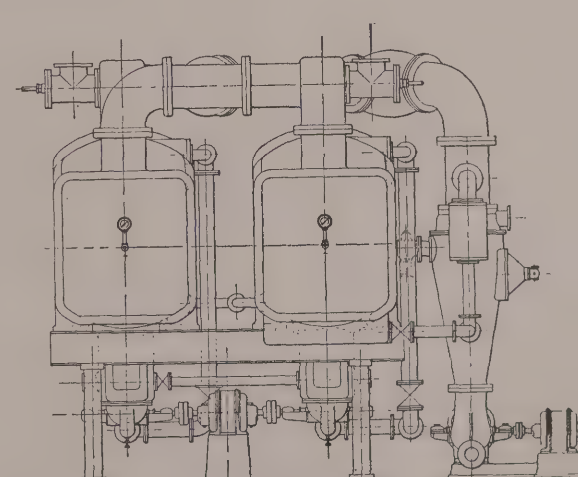


FIGURE 1

In the modern station, distilled water has been adopted, and found to be the answer, in a practical way, to these questions. Figure 1 shows a Double Effect Film Evaporator installed by the Wheeler Condenser and Engineering Co., in the new Colfax station of the Duquesne Light Co., Pittsburgh, Pa. This station is located on the Allegheny river, where the water is not only hard, but contains suspended matter of various sorts.

The evaporator takes steam from the auxiliary line, at approximately three pounds' gage pressure, and a vacuum of twenty-six inches is maintained on the vapor end of the last effect, all of the heat from the evaporator being recovered by the use of the main condenser condensate as the cooling water for the auxiliary evaporator condenser.

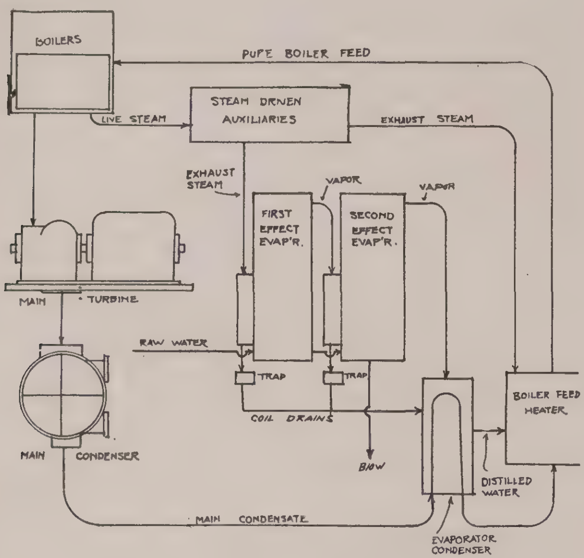


FIGURE 2

How the Evaporator Fits Into the Heat Balance of a Power Station. All Heat Going to the Evaporator is Returned to the Boilers.

The general arrangement of the evaporator is shown in figure 2, regarding the fitting in of the evaporator into the heat balance of the rest of the power station. All of the heat is recovered, and there is no charge against the evaporator for the distilled water produced. The operation of an evaporator is generally understood, in that it takes steam at, say three pounds' pressure, and the distillation of water takes place by maintaining a vacuum on the vapor end of the unit.

The raw water passes into the evaporator, and as the vapors are distilled, the residual mineral content is concentrated. A continuous blow-down, or discharge, is maintained from the evaporator, to remove the solids in solution, and to keep the concentration in the evaporator down to a certain point.

It can easily be seen, that all mineral matter, and sludge, which formerly, without evaporators, passed into the boilers, now are being handled by the evaporator, and provision must necessarily be made to keep the evaporator from being scaled up. Evaporation under a vacuum largely prevents such accumulation of scale, and in the unit at Colfax, the evaporator is arranged in such a way that any scale tending to form on the tubes, does not accumulate, but is continually cracking off, thus making it possible to get the full amount of distilled water from the evaporator at all times, without shutting down, and mechanically removing the mineral scale from the tubes or coils. Continuous operation is very essential for an evaporator unit, in order to have it work into the station operation to the highest degree of satisfaction.

In the unit at Colfax, a surface condenser is installed, to produce the vacuum on the evaporator. Figure 3 shows a jet type condenser, where all of the main condenser condensate passes through it, and is discharged, along with the distilled water produced, and the steam supplied the evaporator, by the tail pump, at the base of the condenser. This type of unit gives a very satisfactory arrangement for many cases, and has advantages over the use of a surface condenser.

Water at the Los Angeles Gas and Electric Co. plant, in Los Angeles, has total solids amounting to over fifty grains per gallon, which is very hard water, and totally unfit for boiler feed, without distillation. The unit shown in figure 3 is being installed in the new station, where it will produce 20,000 pounds per hour of distilled water.

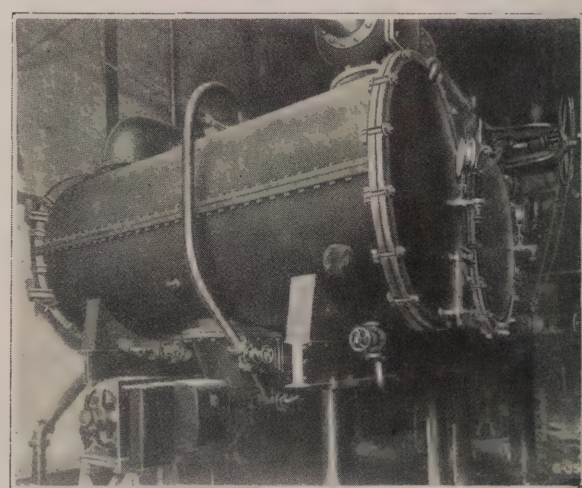


FIGURE 3

A Wheeler Film Evaporator for the Los Angeles Gas and Electric Co., Los Angeles, Cal. This Double Effect Unit is Designed to Operate on Exhaust Steam from the Station Auxiliaries, and to Produce 20,000 Pounds Per Hour of Distilled Water for Boiler Feed Make-up.

In some cases, an evaporator running under a pressure, and using live steam, is advisable. As all the heat is recovered, when the unit is properly designed, just as it is in a vacuum-exhaust steam operated unit, no steam is chargeable to the evaporator. With a station

with economizers, however, this additional live steam added to the boiler feed, heating it up about thirty degrees, decreases the availability of the economizers, and for that reason, it is not advisable to use a pressure type unit with an economizer station. Figure 4 shows the heat diagram with such a pressure evaporator. The boiler feed pump acts as a circulating water pump for the evaporator condenser, as shown.

Up to the present time, the larger and more efficient central stations have been the ones to adopt the evaporator as a device which materially increases the overall efficiency of the plant. As it becomes better known, and engineers familiarize themselves with the operation, and possibilities of such equipment, it no doubt will be found in the smaller stations as well.

It is proving the ultimate solution to the important question of getting proper boiler feed. It has proved itself successful also, from the standpoint of the operating man in the power station, which is just as important, in a different way.

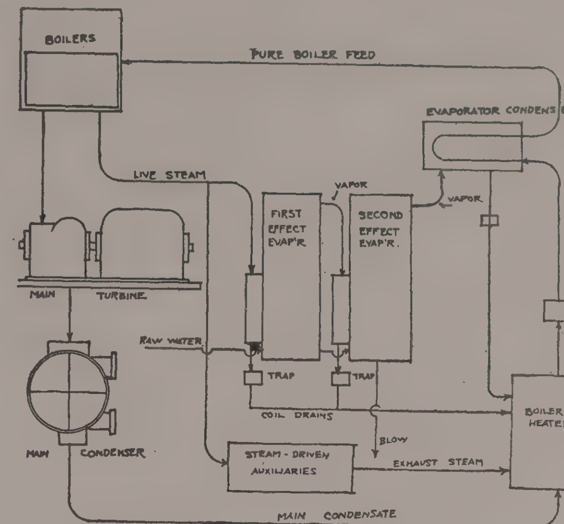


FIGURE 4

Another Arrangement of an Evaporator. Here the Evaporator Uses Live Steam, and the Heat is Recovered and Returned to the Boilers by the Evaporator Condenser.

Some Features of Radioactivity

H. W. Wendt, '23

GLANCING back upon the past of mankind, the whole of man's history is seen to be a struggle with his allowance of energy. Primitive man was forced to subsist upon energy derived from the sun alone. Although probably familiar with fire, he was unlearned in the art of kindling his own.

After he was able to apply fire to his own uses, he was able to draw from natural fuel resources, and so utilize more of the sun's energy. Rapidly glancing over the gulf of time from then to the present, man sees himself master of a world largely nourished by the energy of coal, and humming with the music of inanimate machinery; an industrial civilization, such as the world has never before known, is possible because he utilizes not only the sun's energy in the form of vegetation, but also the sunlight which was stored a hundred million years ago in the form of coal. He is squandering an inheritance, and can well look down to see how long his new source of life will support him.

The question has sometimes arisen as to how the universe has been able to keep going for the millions of years which geologists assure us even our earth has existed in its present form; how stars are able to dissipate so much energy into space eternally, with no signs of exhaustion. Consider the heat evolved from our sun, for instance, of which that which supports the earth is an insignificant trifle. Had coal been the source of the energy which bears the universe along, our sun would have been reduced to cold rock ages ago. Scientists have offered a few explanations, one of which has been that the cooling caused contraction, which in turn produced heat by compression. This action doubtless takes place, but it is ridiculous to ascribe any great amount of heat to it. With the discovery of radioactivity, however, an easy and certain solution is offered, and a probable answer is given to the previous question: the future of civilization when coal is exhausted.

Radioactive bodies exhibit four distinctive and unique properties. They affect a photographic plate in the same manner as light; they excite phosphorescence in certain substances when brought in proximity; they make air, ordinarily an insulator, a conductor of electricity; and, finally, they evolve heat continuously without apparent exhaustion. Since this last is the most interesting and important as far as the future of the universe is concerned, this feature alone shall be discussed.

We are in the habit of thinking only of radium in connection with radioactivity. Radium is only one of a series of about twenty radioactive minerals. The sole reason that it takes precedence over the others is that it is more intensely radioactive, and that its life is neither too long nor too short, relative to the life of man, to be studied conveniently by him. The energy evolved from radium per year is about 150 times that produced in the combustion of the same weight of coal. Its life is about 2,500 years, and therefore before decay is at an end, energy to the extent of a third of a million times that of coal will have been liberated. One fundamentally new ground which this perennial supply of energy opens in the physical science, is the nature of the rays emitted.

The various minerals produce three types of rays, which are classed as Alpha, Beta and Gamma, according to their power to penetrate matter. Beta rays are one hundred times as penetrating as Alpha, and Gamma rays are one hundred times as penetrating as Beta rays. Gamma rays penetrate a foot thickness of solid iron. The theory, which has been held almost from the first concerning the nature of the rays, is that the Beta and Gamma class consist of an intense ejection of electrons, or elementary particles carrying a negative electric charge. The Alpha ray is a continual throwing off of positively charged helium atoms, and so actually consists of matter.

Theories concerning atomic structure have been revised to explain these rays. The accepted nuclear theory states that the atom is a miniature solar system, the negative electron occupying the atomic volume with their orbits about a central mass with a positive charge. This is mentioned only to suggest the infinite complexity of matter as brought out by the discovery of radioactivity.

The Alpha particles which are ejected by radium have been accurately counted by Sir Ernest Rutherford. Per milligram of radium the number per second is 136,000,000. Many inexperienced scientists regard the atomic theory as hypothetical, but when an instrument can be devised which actually counts the atoms entering it the theory seems conclusively proved. This is considered one of the triumphs of modern science.

The speed with which Alpha particles are expelled is about 11,000 miles per second. The swiftest flight of matter previously known has been that of shooting stars, which may attain a speed of twenty to forty miles per second. Since kinetic energy is a function of the square of velocity, these helium atoms would have, mass for mass, energy a quarter million times that of any previously known matter in motion.

Another property of radioactivity previously unheard of in physical science is the transmutation or slow evolution of radioactive elements to elements of lower atomic weight. The dream of the alchemist, "the philospher's stone", so far from being a chimeral idea, is in continual operation in nature. This matter was given a new lease of life about a month ago, when a Yale physicist left for Germany to investigate reports of synthetic gold. According to the theory advanced by Rutherford and Soddy two decades ago, and since proved correct, uranium is the parent metal of a series of almost a score of elements, each of which changes during a definite period to the next heaviest in the series. Four elements intervene between uranium and radium, but if uranium were left long enough, perhaps ten billion years, it would completely change to radium. The element which is produced by the decay of radium is a gas called emanaton, which in turn becomes a metal after an ephemeral existence, showing how total the changes are. After its long succession of changes, it is believed that the parent metal eventually becomes lead, as the end product. The atoms of each newly formed radio-element proceed to disintegrate and expel the fragments of matter which constitute the rays. The old atom is therefore rearranged. If the former radio-element was one which expelled Beta rays, the number of evolving electrons has been reduced, but this does not alter the atomic weight of the new element, since the atomic mass is concentrated in the nucleus. If, however, Alpha rays have been expelled, the helium atom, of weight four units, has been removed from the element formed. and consequently its atomic weight is four units less than that of the preceding element. All this has been verified by experiment.

Transmutation may be observed to go on spontaneously before our eyes in many minerals, and the only problem to be met is, how to control the disintegration and speed it up to an extent sufficient to apply to our needs. All heavy elements would, if they could be artificially transmuted into lighter ones, evolve energy on almost the same scale as what we know as radioactive elements. It is certainly reasonable to suppose that all metals are undergoing spontaneous evolution, but since their period may be extremely long, this evolution is not observable. In addition, it has been shown that if the Alpha rays travel less than five thousand miles per second, they do not respond to the present tests, which may be an additional reason for the apparent non-activity of the less heavy metals. Artificial transmutation is beyond the power of man to effect, but since the method only is lacking, the world awaits the man who will be able to produce

infinite energy, and manufacture elements at will. The goal of the alchemists will be reached, because all that is necessary to make gold from mercury, for instance, is to expel from the mercury atom one Beta particle, which will make thallium; then one Alpha particle which will make gold. It seems quite simple. In addition, energy worth a thousand times the value of gold will be secured.

Soddy in his "Interpretation of Radium" has pointed out that men stand today, with regard to the newly recognized internal stores of energy in matter, where primitive man stood with regard to the energy liberated by fire. The primitive man recognized the energy of combustion from natural conflagrations, but was unable to control it for his own purposes. We are aware of the existence of the energy from the natural process of radioactivity, and at some period of the future, shall doubtless control the action as effectively as we now control fire.

In connection with the ultimate stable product of transmutation, an interesting sidelight is given on the probable age of the earth. The end product, which apparently is stable, is lead. If lead be found in uranium material, it indicates the lapse of a certain length of time during which it formed, one per cent. signifying 80,000,000 years. A better method is by the helium test, every cubic centimeter of which indicates 9,000,000 years. This could not have been initially present, since the gas forms no compounds. The oldest rocks appear to be more than 1,500,000,000 years in age, which exceeds the eons of time which even geologists claim for the age of the earth.

The amount of heat which is radiated into space by the earth has long been known. It has been calculated, that if a layer of rocks of average composition of pitchblende fifty miles thick encrusted the earth's interior, the radium would supply the whole of this lost heat. Therefore there is no difficulty in accounting for the source of heat to maintain existing temperature for the billions of years that uranium would continue to produce radium. If the same reasoning be applied to the universe, the source of cosmic energy is no longer a mystery.

Manufacture of Alum

WILLARD V. JONES, '25

RECALL the time your girl had been away for two weeks? The night before she was to come back, you peered into the mirror and discovered a swelling on your lip. A fever blister! You groaned out the words. Hastily you sought around for a quick home remedy. Then in your dire need you found a piece of alum and by its aid dried up the obstacle in time to make yourself presentable.

Again! You were laboring at Chem. 1 or slaving at Chem. 2. In the course of time you learned that Aluminum sulphate united with Alkali salts to form double salts or alums of the general type: $R_2SO_4.Al_2(SO_4)3. 24H_2O$ and straightway you proceeded to forget the formula. Perhaps you wondered how this alum was made and then again perhaps you didn't. However, we will give you the benefit of the doubt and proceed to explain.

Bauxite, the cheapest aluminum ore obtainable, is used for the raw material. It is a hydrated oxide of aluminum and iron. The specifications for the ore call for an average aluminum content of 55 per cent., the iron content not to exceed .2 of 1 per cent. The smaller the iron content, the better the bauxite. Most of the bauxite is obtained from the South, notably Georgia and Alabama, though considerable is imported from South America.

The bauxite is dried and then disintegrated in a crusher. From the crusher it is conveyed to the "attack boxes". These are lead-lined boxes heated with exhaust steam; 5,000 pounds of bauxite is mixed with 4,700 pounds of 50° Beaume sulphuric acid, the ordinary chamber acid, to form one "attack". This "attack" is boiled for four hours after which time it is tested with propalein, a special indicator, to see if any acid has remained uncombined. The "attack" must show a slight basicity, and if it does not, more of the bauxite must be added.

The presence of unreduced iron in the alum is extremely undesirable because the ferric compounds formed give the alum a reddish cast and no one wants red alum. Not that it makes any difference in the alum, but you can't convince a customer that red alum is of any use. We say no one but we recall one customer who received a batch of slightly red alum. The manufacturer rested uneasily over the outcome, so imagine his surprise when the customer sent in a rush

order for more with the specifications that it should be redder. The astounded manufacturer was in a quandary for there was no time to prepare a batch of unreduced alum. The idea of putting red lead in ordinary alum for a pigment was discarded and finally the manufacturer hit upon a novel idea. He ordered his men to scrape the reddish-brown rust from the beams above the attack boxes and powder it. This made an excellent pigment, for, when mixed with the ground alum, a nice shade of red was obtained at negligible cost. The customer was pleased, the manufacturer was happy. Everyone was satisfied. It was Utopian.

Ordinarily, the iron is reduced from the ferric to the ferrous state while in the "Attack boxes". A solution of barium sulphide is used for the purpose. The ferric sulphate is reduced to ferrous sulphate, the barium sulphide going to barium sulphate and settling out as an insoluble white residue.

The concentration of the alum liquor at the end of the boiling is 46°B. This liquor is drained off into settling boxes, diluted to 28°B. and allowed to settle. From the settling boxes, it is pumped up to the "serpentine boxes" which are also lead lined and steam heated. Here the liquor is boiled down to the requisite concentration, either 58° or 62°B. according to the desired strength of the alum. The hot concentrated alum liquor is poured on lead-covered floors where it solidifies in a few hours. It is broken up, put through crushers, packed and sold as 17 per cent. aluminum sulphate. Extra concentrated alum of 22 per cent. strength is obtained by putting the 17 per cent. alum in driers and drying it for twenty-four hours. The greater quantity of alum is sold to paper manufacturers for use in the making of paper, but considerable goes to water works for the purification of water.

Certain customers desire an alum free from iron and this is responsible for the manufacture of "Iron Free Alum". The liquor for this process is not reduced by Ba S in the "attack boxes" but is drained directly into tubs and treated with sodium manganate which immediately turns to the red sodium permanganate. A hydrated double oxide of iron and manganese forms and settles to the bottom of the tub as a purple sludge. This treatment is continued three times before all the iron is taken out. The sludge with its iron and manganese content is drawn off, pressed free from water and put into a tower where it is saturated with the vapors of burning sulphur. Manganese sulphide is formed and is added to the alum solution to take out the red permanganate color. This it does by reducing the permanganate to the colorless and soluble manganous sulphate. Bisulphite of sodium is then added to make the solution water-white, acting as a reducing agent in a way similar to the manganese sulphide. From then on the process is the same as for ordinary alum. A much whiter compound is obtained entirely free from iron. It is much used as a pickling alum and in the making of fine white paper.

You may have been confused by the use of the term alum in reference to aluminum sulphate. However, that is simply a trade name. The manufacture of ordinary alum or the so-called crystal alum is comparatively simple. The liquor from the "attack boxes", from which the iron has been reduced, is pumped into tubs and heated to boiling. A charge of solid potassium sulphate or ammonium sulphate, according to the desired kind of alum, is added and the whole agitated till all the solid melts. This so-called "melt" is evaporated to the requisite Beaume and pumped into boxes. Lead strips are suspended in the solution and the boxes are covered with a coating of paraffine to keep out dirt. The crystals deposit on the lead strips and grow to very large proportions. A period of eighteen days usually suffices for crystallization. The residual liquor or "mother liquor" is used for a recrystallization and the liquor from this or "grandmother liquor" is subjected to another recrystallization. The crystals are separated from the strips and sold either in large crystals or in the ground condition. The majority of crystal alum is used medicinally and for the manufacture of films. Formerly much of it was used as a mordant in dyeing but it is gradually being superseded for this purpose by aluminum sulphate.

An interesting feature of the alum plant is the manufacture of aluminum hydrate. Iron-free alum liquor is used, i. e., liquor from which the iron has been extracted by the sodium manganate process. Part of this liquor is mixed with a weighed amount of sodium carbonate solution. The whole is agitated and ALL $(OH)_3$ precipitates. Remember in "qualitative" you learned that the hydroxide of aluminum was precipitated by a soluble carbonate instead of the aluminum carbonate that you would expect? Well here it is worked practically. This white hydroxide liquor is pumped into presses and washed with water for three hours to dissolve out the excess sodium. The pressed white cakes, having much the appearance of brick ice-cream, are placed in driers and dried gently till no more than 5 per cent. moisture remains. It must not be allowed to bake which the presence of iron is sure to cause it to do. When ground it is an extremely fluffy, velvety white powder much desired and quite expensive. It is used as a body for inks and fine oil paints.

Heat Treatment of Metals

A Recording Furnace in Our Laboratory

L. N. Gulick, B.S. in M.E.

IF A specimen of steel, sufficiently high in carbon content to permit hardening, is placed in a furnace, and subjected to a gradually increasing heat, a chemical and physical change will take place. The chemical change is generally explained as the point at which the iron and iron carbide of the steel form a complete solution, one in the other. The heat necessary to bring about this chemical change is absorbed from the steel specimen, and results in the physical change, evidenced as a lowering of temperature for a very short interval. As soon as the chemical transformation has been completed, the temperature of the specimen continues to rise as before. If, in turn, the sample is slowly cooled, the reverse of the above reaction takes place, but at a slightly lower temperature.

These points are commonly known as "decalescence" and "recalescence" points respectively, and the former is of great value to the steel treater in determining the proper hardening temperature. Particularly is this true of carbon tool steels and alloy steels, other than "high speed". In fact, in the case of high speed steel the decalescence temperature is of no value at all in determining the satisfactory hardening temperature, since it generally lies several hundred degrees above the critical point.

With carbon and alloy steels, the case is different, for were it possible to quench a specimen at the instant that the complete solution took place, so as to "trap" the steel in that condition, the finest qualities would be obtained. Fineness of texture, maximum hardness, minimum expansion and contraction would be contained in one piece. The condition of instant quench is approximately obtained in practice by permitting the temperature to rise 50° to 75° above the decalescence point. This permits thorough heating, and allows for the inevitable drop in temperature while transferring from the furnace to the quenching bath. Too much heating above critical is, however, just as harmful as not enough, since a coarse grain is sure to result.

It can be seen from the discussion in the foregoing paragraphs, that proper determination of the critical temperature is essential to hardening a specimen for efficient use. The common method in the past was to quench a given composition of steel at various temperatures until satisfactory results were obtained, and then harden all samples of like composition at the same temperature. It often happens, however, that, due to some inherent characteristics, like chemical compositions do not always have the same critical points. This naturally results in having to scrap some of the work. If some form of recording pyrometer can be used, which will indicate small changes of temperature in the specimen to be hardened, the above-mentioned difficulty can be overcome, as will be shown later.

A complete steel hardening and drawing outfit manufactured by the Leeds and Northrup Company was recently installed in the Forging Laboratory of the Mechanical Engineering Department. The electrical resistance hardening and drawing furnaces are in the front, the heating spaces of which are ten inches in diameter by fourteen inches deep. The hardening unit runs to 1800° F., and the drawing unit runs to 1200° F. On a shelf are the recording pyrometers, opposite the units which they control, and similar to each other in every respect, except that the drawing furnace recorder can be set to maintain the temperature at any desired point, acting in conjunction with the relay panel below it. Below the hardening furnace recorder is the controlling rheostat for that unit, making perfect temperature adjustment possible.

The recording pyrometer is made to operate on the potentiometer system, and the galvanometer pointer serves to operate (when deflected) as an indicator to a motor-driven mechanism which moves a contact over the slide-wire the proper amount, and keeps the opposing e.m.f. balanced with the thermocouple e.m.f. If the galvanometer pointer ceases to be deflected, it is an indication that the e.m.f. of the thermocouple is constant, and consequently that the temperature at the hot end of the thermocouple is neither rising nor falling. While the contact is being moved over the slide-wire, the recording pen is being moved horizontally a like amount and indicates at all times the hot end temperature. At the same time the record sheet is moving vertically at a definite rate, with the result that a continuous red ink curve of temperature against time is plotted.

But the important thing about the recorder is that it is so delicate that it will show minute changes of temperature in the specimen when the latter is placed in contact with the thermocouple. This occurs even though the furnace temperature is constantly increasing, and results in a decided bend or hump in the re-

(*Continued on page 25.*)

TOWNE TOPICS

MEN ABOUT TOWNE CLUB

Although the school year has but little more than started, the Men About Towne Club is already planning actively for the Engineers' Show of 1922. As has been the custom, the production will precede the Christmas Holidays. The dates of December 13th, 14th and 15th have been selected tentatively and these nights will probably see the new show—as yet unknown—presented for the first and last times.

Officers for the current year are:

President—Robinson, Ch.E. '23.

Vice-President—Sutherland, M. E. '24.

Secretary—Arthur, E.E. '23.

Treasurer—Manz, E.E. '23.

Manager—Lipp, Ch. '23.

As in other years there will be competition for the honor of writing the book. Any undergraduate of the Towne School is eligible, and it is hoped that many of our full-fledged and embryo humorists will endeavor to transcribe their oral witticisms to paper. There is the usual $25 prize for the chosen book. Keep within these limits: two acts of one scene each, to take about one hour and a half to perform. There are about a dozen musical numbers, the melodies for which also are written by the students. Any of the club officers will gladly receive manuscripts and scores. Competition closes October 28th.

The club is fortunate in having many of its "stars" back this year and everything points to another successful production. "All for Love" and "All for Nuttin'" of last year and two years ago are still fresh in the mind, and it will be no easy task to sustain the reputation for cleverness that the club has acquired. The music and dancing are always particular features.

A large turnout is expected when the call for candidates is issued. Freshmen in particular are urged to try out for it will be up to them to carry on the traditions of the club in a few years. Anyone making the show, in any capacity, is eligible for club membership, although freshmen must be content to wait a year. This is a good opportunity to tune up for Mask and Wig and to get into an activity that all Towne is proud of and one that is well known on the campus.

ALEMBIC SOCIETY

The Alembics, the Chemical Senior Society, for this year are: Cubberly, Lipp, McMullen, Robinson, Stehle and Wall.

HEXAGON SOCIETY

The Hexagon Senior Society is composed of the following men: Miller, Morgan, Murdock, Strain, Wheeler and Zimmerman, elected at the close of the last semester.

PRIESTLEY CHEMICAL SOCIETY NEWS

Encouraged by the successes of last year's activities, the Priestley Club is very enthusiastic over the bright outlook for the new school year. A drive for members among the Freshman class is already under way, and we can confidently hope to add many more names to our already greatly augmented enrollment. The membership fee will probably be a little higher this year, but the extra money entitles the new member to one of the newly adopted pins—an Erlenmeyer flask bearing the legend "Priestley Chemical Society", in black letters.

J. William Lipp, '23 Ch., President of the Society, intends to bring before us more lecturers of the same calibre as those who entertained us so well at our smokers last year.

It is hoped that another edition of the annual Priestley Chemical Society Show will be possible. We recall with satisfaction the popularity of last year's production, "Who's Zoo in Chemistry".

ENGINEERING ASSOCIATION

After three days of intensive membership campaigning, the Association held its Freshman Reception and first smoker of the year, on Wednesday evening, October 11th. A goodly number of white-buttoned yearlings appeared and were welcomed in rousing fashion by the upper classmen. Advice and exhortation flowed freely from the lips of Dean Clewell, President Miller, Coaches Heisman and Stewart and the other notables present.

If but a fraction sinks in and lodges somewhere within the shaven craniums, what a promising group this class will be—maybe.

The Men About Towne Club entertained with a novel dancing act, and music was heard by some during conversational lulls. Refreshments and smokes topped a "bully" evening, as Professor Fernald would say.

The Association is young, but it has solid foundations. It encourages and supports all Engineering activities, and through the medium of its frequent meetings and smokers affords contact with each other and with interesting phases of engineering and scientific work.

You can't be a good Pennsylvanian if you're not a good Engineer. Support the Engineering Association!

ALPHA CHI SIGMA

There has been a new honorary society on the Engineering campus for some little time. Alpha Chi Sigma, the national chemical fraternity, has established its Alpha Iota chapter at Pennsylvania, with headquarters in the Harrison Laboratory. There are thirty-four chapters in all the leading scientific institutions of the country, as well as numerous alumni branches. Practically the entire chemistry faculty are members here, and the fraternity emphasizes high grade of character and personality as well as scholastic attainments.

TAU BETA PI

The attention of all freshmen engineers is called to the existence of a chapter of Tau Beta Pi at this University.

Tau Beta Pi is an honorary engineering fraternity of national reputation to which all students in the Towne Scientific School who maintain a high scholastic standing during the first three years of their course are eligible for election.

The objects of this organization are, "to mark in a fitting manner those who have conferred honor upon their Alma Mater by a high grade of scholarship as undergraduates, or by their attainments as alumni; and to foster a spirit of liberal culture in the Engineering Schools of America."

CIVIL ENGINEERING SOCIETY
A. S. C. E.

Plans for the present term have been formed, and numerous meetings are scheduled at which prominent engineers will lecture. A very successful year is predicted as the officers of the society have the hearty support of Prof. Berry, the new director of the Civil Engineering Department, and the entire civil engineering faculty.

A membership committee has been appointed, with Mr. R. Beatty as chairman, and a 100 per cent. enrollment is expected. The following executive committee has been approved by President Lindsay.

Senior—Klauder.
Junior—Test.
Sophomore—Firth.
Freshman—

A member of the freshman class will be appointed next month.

The dues for the year will be $1.25 and will entitle the Civil Engineering Society men to membership in the Student Chapter of the American Society of Civil Engineers and the Engineering Association of the University.

WHITNEY ENGINEERING SOCIETY

Ticket Committee: Chairman, Joseph Hewlett, Jr.; William Foley, Harry Walker, George Russel King, Ralph Van Kleck, Samuel Thenhard, Joseph D. Bush, Cryil O'Toole.

Entertainment Committee: Chairman, David Beard; Edward Shumway, Joseph Brown.

Refreshment Committee: Chairman, Howard Ross; Theo. N. Spencer, Orne P. Arnison.

At this time a word might be mentioned for the benefit of the Freshmen, in regard to what Whitney is and what it does. This is the society for undergraduate Mechanical Engineers in the Towne Scientific School banded together not only for the purpose of sociability, but also with the idea of aiding men along the educational line in the form of lectures and moving pictures.

This year Whitney hopes to obtain some of the Wharton School Professors to speak with the idea of giving the engineers an insight into business which is a point of vital importance to him.

Later on it has also been planned to offer a prize in the form of money for the best article on a technical subject. This will only be open to members of Whitney.

The dues for the year will be the same as last, namely $1.25. This automatically makes a member of the Whitney Engineering Society a member in the Engineering Association. Every Mechanical Engineer should become a member and we not only hope but expect 100 per cent. from the four classes.

Engineering News

The University of Iowa is having an all-steel stadium erected. Eventually it will be completed into a double-decked bowl. The cost will be about $5.50 per seat and when completely finished it will seat 40,000 persons. This is the first instance of an all-steel grandstand. The American Bridge Co. is fabricating the material on the basis of a new design by B. J. Kambert.

—*The Transit* (Iowa).

Sixty per cent. of the Presidents, operating Vice-Presidents and General Managers of the railroads of this country began their railroad careers in the engineering departments.—*Wisconsin Engineer.*

Iowa State College sponsored the first radio convention held in that state. It took place in April under the direction of the campus radio club sponsored by the Engineering Extension Department. The meetings were attended by over nine hundred people. Several large companies exhibited the latest equipment. During the convention the college radio set was in operation and broadcasted music and the results of the Drake relays.

—*Iowa Engineer* (Iowa State).

Iowa State is building a new $225,000 Physics Laboratory which will be completed by January 1st. John S. Dodds of the Civil Engineering faculty is the engineer in charge of the work.

—*Iowa Engineer.*

The New York Electrical Society held its 401st meeting on May 26th. Dr. Frank B. Jewett, Vice-President of the Western Elec. Co. and President of the A. I. E. E. was the principal speaker and gave a brief description of the developments which have made possible the loud speaking telephone, multiplex carrier current telephony and radio telephony.

A Dry Cell Vacuum Tube, which can be operated ninety-five days on a number six dry cell, if the average daily use of the tube is one hour, has recently been developed. This tube required a potential of but one and one-tenth volts and a current of two-tenths amperes, amounting to a power consumption of less than a quarter of a watt. The filament is platinum, coated with certain oxides, the thickness of which is about one-eighth that of a piece of tissue paper, and the width about one-hundredth of an inch.

Einstein is Explained visually by a six thousand foot motion picture film recently completed in Germany. The film will be exhibited shortly in this country. The script was written by six European professors and it is expected that it will explain to many the intricacies of Einstein's theory. The film consists mainly of drawings and trick pictures by means of which the main points of the theory are shown in a simple manner in a way which everyone can grasp.

New Power Plant for St. Louis. The Union Electric Light and Power Company of St. Louis has started work on a big new generating plant to cost twenty-five million dollars, and to have an ultimate capacity of two hundred and forty thousand kilowatts. The use of electricity has grown enormously within the past few years at St. Louis, and the reason given for the construction is that the power resources of the company, which are the Keokuk dam on the Mississippi, with a capacity of sixty thousand kilowatts available at this time, and the Ashley Street station, with its capacity of one hundred thousand, will be exhausted by 1923 at present rate of consumption increase.

M. Perot of the Mendon Observatory in France recently stated that he believed he had physically proved that time passes more slowly on the sun than on the earth, thus proving the correctness of Einstein's theory of time. The Einstein theory is that time in various parts of the universe varies with gravity. Gravity on the sun is twenty-seven times stronger than on the earth. Dr. Perot compared, in the spectroscope, the vibrations of atoms of the same metals burning on the sun and on the earth. His experiments showed that the vibrations of those on the sun are much slower than those on the earth. The difference in vibrations was almost exactly that provided for in Einstein's theory.

EDUCATIONAL AND PROFESSIONAL NOTES

New books of interest to the engineer are as follows:

"Modern Methods of Welding as Applied to Workshop Practice" by J. H. Davies.

"Research in Industry" by A. P. M. Fleming and J. H. Pearce.

"The Electro-Metallurgy of Steel" by C. C. Gow. Note: A treatise on Electro-chemistry.

"Kinematograph Studio Technique" by L. C. Macbean.

"The Young Man and Civil Engineering" by George F. Swain.

"The Economic Resources of Italy" by the "Credito Italiano."

"Reinforced Concrete Simply Explained"* by Oscar Faber.

* Of great value to the Engineer or Architect who has neither the time nor inclination to study the subject from the standpoint of the specialist in concrete. Covers far more ground than the general engineering handbooks. Has valuable diagrams, tables and formulas.

"Steam Turbines" by William J. Gondie.

New Airship Gas. Dr. Edward Curran, of the International Transportation and Manufacturing Company of Los Angeles, recently demonstrated a new gas, *currenium*, having a weight of six and two-tenths pounds per thousand cubic feet at a pressure of thirty inches of mercury and a temperature of forty degrees fahrenheit. Its lifting power is practically equal to that of hydrogen and it has the advantage of being incombustible, except when very greatly diluted with oxygen. Currenium can be produced electrolytically at a cost of one hundred dollars per thousand cubic feet. The process was developed in 1918, but the inventor was not satisfied with the purity obtained by the process as first developed and continued his research work to date.

—*Tech. Journal.*

California Air Line. Regular air-plane passenger service between San Francisco and Los Angeles was begun a little more than a month ago when six planes made their first trip for the operating company.

The Long Island R. R. has oiled its roadbed, using over 150,000 gallons for this purpose. The oil is contained in a tank of 8,000 gallons capacity and is spread over the tracks and also to three feet on each side. C. D. Baker, the General Superintendent, says the oil not only eliminates dust but also prolongs the life of the ties and causes water to readily run off the ballast instead of seeping through it to cause injury to the roadbed.

Is Einstein Wrong? That the Einstein Theory contains a fundamental error is a claim made by M. Guillaume who hopes to prove the error by his ellipsoid method. Ex-Premier Painleve, a celebrated mathematician, has arrived at the same conclusion by a different method. M. Guillaume is of the same family as Albert Guillaume, a recent winner of the Nobel prize.

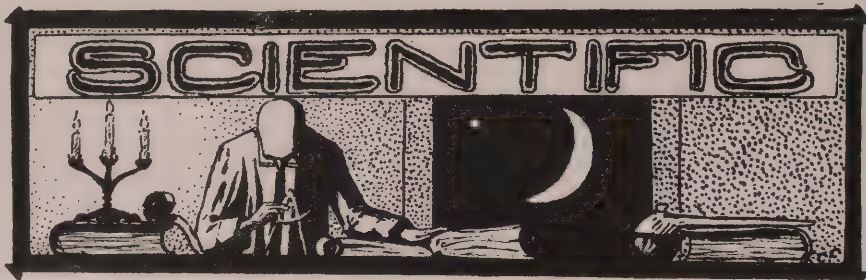
Vehicle Tunnel Under the Hudson River. Work has been started at West and Canal Streets in New York. The completed tunnel will be ready in about four years and is to cost $19,331,723. The tunnel will have twin tubes.

The University of Chicago departments of political economy and education have put into permanent form the series of bulletins "Lessons in Community and National Life," put out by the Food Administration and Bureau of Education during the war.

Dr. Harvey C. Hayes, Physicist of the Naval Engineering Station at Annapolis, has designed a new apparatus which is a radio sounding device for registering ocean depths. The device has been tried out by the Navy and has proved a complete success, registering automatically and instantly depths from 2,400 to 28,000 feet in the experiment. Sound from an oscillator, installed in the ship, is projected against the ocean bottom and rebounds, being received by sensitive apparatus. The elapsed time is automatically measured. This invention will revolutionize the charting of ocean beds and is a big step forward over the old plumb line.

According to a press announcement, the Universities of Wisconsin, Iowa and Nebraska, Tufts College and New York University have announced lecture courses to be broadcasted from their respective radio stations. Dean Lough of N. Y. U. is also quoted as saying that "loud speakers" are to be used in the various classrooms, so that one professor may lecture simultaneously to several classes. At Tufts College, one feature of the plan is to have a course of a popular nature for boys of about fifteen years of age. At certain specified periods the professor will answer by radio the questions which have been submitted to him by mail.

At the University of Arizona the authorities have undertaken a scientific study of dormitory life with the idea of working out a system most conducive to general health. As a result of this study all dormitory suites have been equipped with sleeping porches. The students must use these sleeping porches or they cannot live on the campus.



CALIFORNIA POWER DEVELOPMENT. The Southern California Edison Company has its plans well under way for its new hydro-electric power plant. Big Creek Number Three, which will be the fourth and largest plant in the company's extensive Big Creek Development. It will have an ultimate capacity of one hundred and fifty thousand kilowatts and will tie in with the other plants in the district feeding the two hundred and seventy mile transmission line to Los Angeles. For the initial installation there will be three 28,000-kva. vertical water-wheel generator units; seven 18,500-kva., 220,000-volt transformers; six 36,700-kva., 220,000-volt auto transformers; and 24 high-tension circuit breakers for 220,000-volt service, with miscellaneous auxiliary and switching equipment, all of which has already been ordered from the Westinghouse Company.

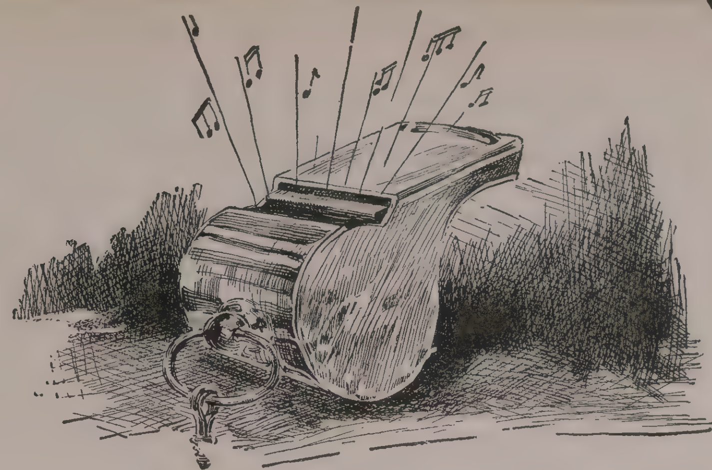
The generators will have a normal continuous full load rating of 28,000-kva. at 89.4 per cent. power factor and will be three-phase, for operation at 50 cycles and 11,000 volts at 428 r.p.m. The exciters are to be direct-connected. The generators are to be designed for operation at 60 cycles and 12,500 volts at 514 r.p.m.

The transformers will be single-phase, 50 cycles, oil-insulated and water-cooled and are designed to step up from 11,000 volts at the generator to 220,000 volts on the line. The high-voltage winding will be connected in star with graded insulation and the neutral solidly grounded. They will be the largest 220,000 volt transformers ever built.—*Power.*

Through the commonwealth fund of New York, Dr. Frank N. Freeman of the University of Chicago has been authorized to spend $10,000 in research work to determine the value the motion picture has in the education of children. In this connection Dr. Freeman said: "There seem to be two general problems for solution. One is to determine what can best be taught by moving pictures and to devise means of enlarging this field and the second is to find ways of improving the pictures themselves. Visual education at present is not systematized. Motion pictures will not spread over the whole curriculum, but will be incorporated as a part of the school work. What is best to show is a matter for much study. Valuable results are obtained in the presentation of objects which the child has never seen. Experimental work now is going on in the Universities of Chicago and Illinois and in at least two cities where there are large school systems."

INTERESTING METEOROLOGICAL EXPERIMENTS were recently begun at Kelly Field, Texas, under the direction of the meteorological section of the War Department. Small hydrogen filled balloons carrying instruments for recording pressure, temperature, and other conditions will be sent up in pairs to a height of fifteen miles. At this height one balloon will burst and the second, not having sufficient capacity to carry the weight of the instruments, will drift slowly to earth.

—*Tech. Journal.*



It will pay you to listen to this music

ALL over the country the whistle is blowing for the kick-off, the start of that great game—another college year.

Be on your toes when the whistle blows. A good start will carry you well on toward your goal.

Let the football candidate start by working away till his muscles ache from bucking the line.

Let the aspirant for manager put in careful study of his team's needs, always eager to help —arranging a trip or carrying a pail of water.

Let the publications man be alert for news and tireless in learning the details of editorial work.

Whatever activity you come out for, crowd a lot of energy into these early Fall days.

And if a good start helps win campus honors, it helps win class room honors, too. The sure way to be up in your work is to aim now for regularity at lectures, up-to-date note-books and particular attention to the early chapters of text-books, thus getting a grip on the basics.

This is best in the long run, and—selfishly—it is easiest in the long run. That is, if life after college is made easier by the things a bigger income can buy.

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

Western Electric Company

Since 1869 makers and distributors of electrical equipment

Number 21 of a series

THE CONCRETE HORSE-SHOE

(*Continued from page 8*)

concrete was finished rough to give secure footing. Upon the face of the risers are secured the brackets upon which rest the seat lumber. The brackets are held secure in the concrete by means of lag screws. Since the seats are held from the concrete this does away with the unpleasantness of sitting directly upon concrete, as is the case in most concrete stands, and also insures sufficient heel room.

All entrances for the new stands are from the streets and the use of ramps instead of stairs greatly facilitates the handling of the large crowd as well as lessens the possibility of accidents. Corridors and concourses make possible trips from one side of the field to the other. The stands are faced in brick and ornamental stone arranged in arches which give the structure a massive and beautiful appearance. The excess space beneath the stands has been utilized for team room, rifle range, squash courts, laboratories, rowing rooms, etc.

Taken as a whole the stadium presents a beautiful, useful and lasting tribute to any athletic endeavors undertaken by this, our Alma Mater. May these endeavors be as successful as the planning and erection of this huge monument.

George Boyd, '14, is with the firm of Day & Zimmerman of this city. He lives at 1909 Spruce Street.

Ray Stanton, '14, is with the firm of Steel and Company, builders, of Philadelphia.

Samuel Ourbacker, '14, is selling insurance for the Equitable Life Insurance Company of Philadelphia.

R. S. Landes, '14, is with the Celluloid Company of Newark, N. J. His home address is 73 Carnegie Avenue, East Orange, N. J.

Robert B. Ferguson, '15, is with the William Cramp and Sons Shipbuilding Company, Richmond and Norris Streets, Philadelphia. He lives in Audubon, N. J., at 42 Lafayette Road. In his senior year he was intercollegiate champion high hurdler.

Launcelot W. Suckert, '15, architect, formerly associated with Albert Kahn, has opened offices in the Capitol Theatre Building in Detroit, Michigan.

HEAT TREATMENT OF METALS

(*Continued from page 15*)

corded curve at the time the steel is passing through the critical point. In this way is indicated, without error, the proper time at which to quench the specimen, regardless of previous experience, and even with no knowledge of the chemical composition.

In the electric furnaces are embodied all of the advantages of electrical heating, absolute control of temperature, lack of noise common to oil and gas furnaces, minimum oxidization, cleanliness, almost complete absence of radiated heat, and minimum space occupied.

In the recorders are embodied a permanent record of performance for future reference, and, best of all, accurate determination of critical points for hardening, and uniform temperatures for drawing.

L. H. Forstner, C. E. '14, is now Plant Engineer for David Lupton & Sons Co., Philadelphia, Pa.

Chas. Hovies, Ch. E. '20, has accepted a position as chemist with the Pure Food and Drug Department for the U. S. Government. He is located at present in New Jersey.

Chas. Albrecht, Ch. E. '18, is employed as a chemist with the Western Electric Co., at Leonia, N. J.

W. A. Spooner, Ch. E., is manager of advertising for the *Chemical and Metallurgical Engineering* magazine.

C. H. Kraft, Ch. E. '14, is working on the electrical installation line at Weehauken, N. J.

R. T. Irwin, Jr., M. E., '20 is connected at present with the Wheeler Condenser and Engineering Co. at Carteret, N. J.

FROM GILBERT'S DE MAGNETE —

"WORD MONGERS" *and* "CHATTERING BARBERS"

"Word mongers" and "chattering barbers," Gilbert called those of his predecessors who asserted that a wound made by a magnetized needle was painless, that a magnet will attract silver, that the diamond will draw iron, that the magnet thirsts and dies in the absence of iron, that a magnet, pulverized and taken with sweetened water, will cure headaches and prevent fat.

Before Gilbert died in 1603, he had done much to explain magnetism and electricity through experiment. He found that by hammering iron held in a magnetic meridian it can be magnetized. He discovered that the compass needle is controlled by the earth's magnetism and that one magnet can remagnetize another that has lost its power. He noted the common electrical attraction of rubbed bodies, among them diamonds, as well as glass, crystals, and stones, and was the first to study electricity as a distinct force.

"Not in books, but in things themselves, look for knowledge," he shouted. This man helped to revolutionize methods of thinking—helped to make electricity what it has become. His fellow men were little concerned with him and his experiments. "Will Queen Elizabeth marry—and whom?" they were asking.

Elizabeth's flirtations mean little to us. Gilbert's method means much. It is the method that has made modern electricity what it has become, the method which enabled the Research Laboratories of the General Electric Company to discover new electrical principles now applied in transmitting power for hundreds of miles, in lighting homes electrically, in aiding physicians with the X-rays, in freeing civilization from drudgery.

General Electric Company

General Office *Schenectady, N.Y.*

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THE TOWNE SCIENTIFIC SCHOOL JOURNAL

December
1922

Vol. VI. University of Pennsylvania No. II

Engineering for the Buyer

It is not enough that electrical apparatus should be carefully conceived, skillfully designed, and exactingly manufactured.

Engineering, to fulfill all its functions, must go beyond these necessary steps and do a still more enlightened service. It must *apply the apparatus to its uses,* so that not only in design and construction but in service as well, all the conditions that must be reckoned with are fully satisfied.

This function of Westinghouse application engineering covers many fields, and charges itself with many responsibilities. It is engineering that concerns itself with almost every aspect of business, central station, transportation, industrial, mining, electro-chemical, etc. It has the buyer's interest constantly at heart.

Westinghouse Application Engineering works with salesmen, with buyers, with consulting engineers, with contractors, and with service and repair men; it finds and investigates new fields; it checks the behavior of apparatus, old and new; it is a bridge over which information passes freely in both directions between Westinghouse and its thousands of clients and friends.

Be glad that you are to live and work in times when the spirit of service dominates commercial operations. The greatest change that has occurred in business in the last few decades has been in the minds of men. No longer need the buyer beware for it is now known that the seller's obligation reaches beyond the completion of the sale; and that it is both wise and right that every reasonable effort be made to give the buyer full value in both product and satisfaction. The practise of this policy requires engineering of the highest type in research, design, manufacturing and every other phase of Westinghouse operations, but nowhere to greater degree than in the field of application engineering, which is essentially engineering for the buyer.

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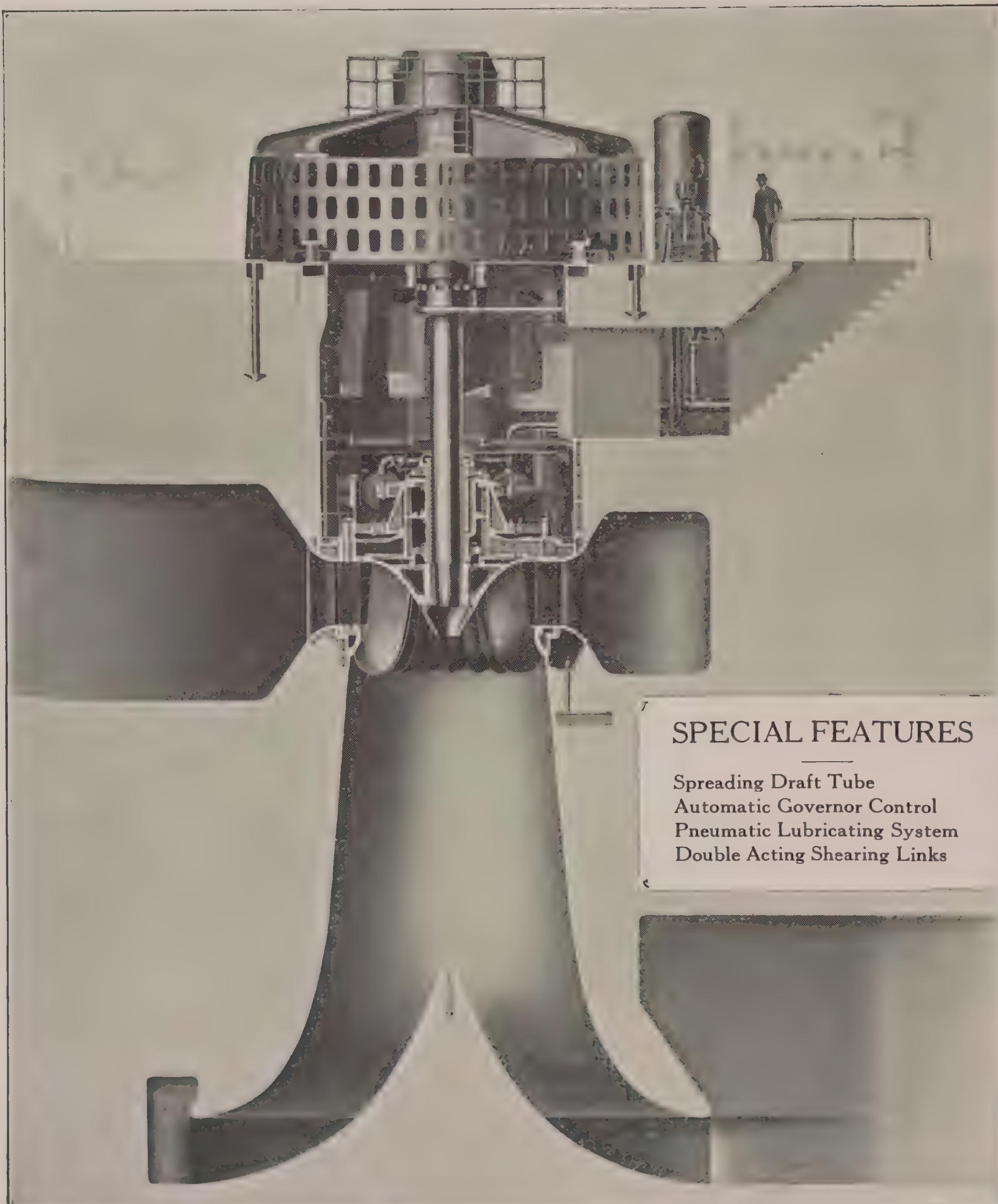

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THE

TOWNE SCIENTIFIC SCHOOL JOURNAL

VOLUME 6 | DECEMBER, 1922 | NUMBER II

LEADING ARTICLES IN THIS ISSUE

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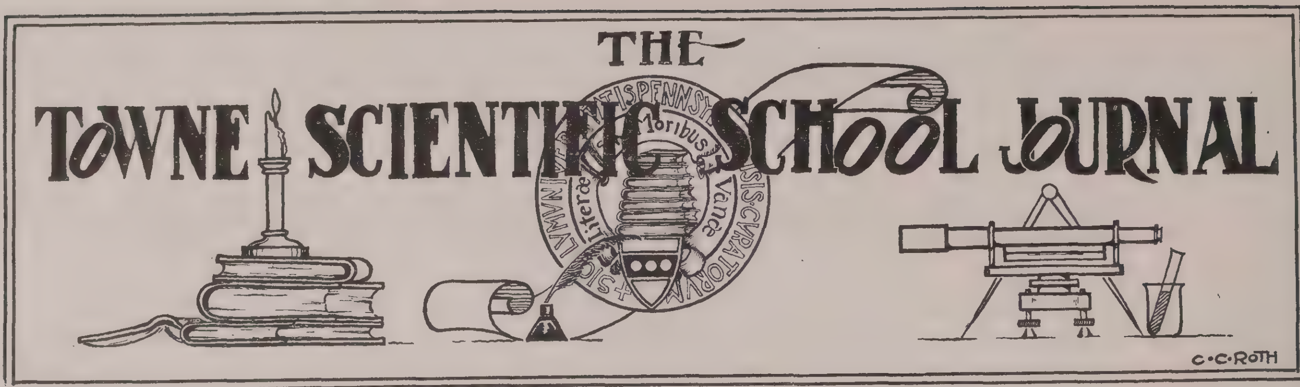


In Retrospect

IT IS not our desire to revive again past scandals or to assume the attitude of reproachful criticism. It is for neither of these reasons that we mention again the impromptu and short-lived celebration on the Monday following the State game. A goodly measure of censure and contempt has fallen upon Towne and the Engineering students, following the events of that hectic morning. Nothing that can be said in condonation will suffice to remove that blot. Perhaps it was due us; we had become a bit too rocky, our pride had swollen until it reached the breaking point.

Engineers work hard—admitted. They also play hard—as has been shown. Their enthusiasms seem to be excessive; also their dislikes. They should cultivate the virtue of moderation, moderation in all things. The Greeks epitomized the correct conduct of man in these few words. In engineering terms we want a straight, smooth curve.

We needed a lesson, a little one. We got a big one. It is not too rash to predict that we will be chastened for some time. Don't go too far into the gloomy depths. Just drop back to normal and stay there.

Let's Go, Fresh

A NEW idea has been conceived and placed in operation in the Towne School. For the first time in the Engineering School, freshmen have been received into active working co-operation with upper classmen in directing school affairs. The executive Committee of the Engineering Association, the directing body of Towne, has decided that the addition of four freshmen, one from each sub-society, to its numbers, would greatly aid in bringing yearlings in closer touch with school activities. Many freshmen lack initiative to come out for activities because of a lack of information. The advantage of this system can then readily be seen as it will give the Freshmen a source of information to which they can readily go. Go to it, Frosh. Ask your representative. Make him work.

Honors

THE time is coming, in fact is already here, for the distribution of honors to the seniors, in the form of election to various honorary societies and fraternities. Honors won in scholastic endeavor, honors for athletic attainments, honors for more indefinite achievements are being conferred every day; orders for pins and keys are bringing joy to the jewelers' hearts. The great majority of them are deserved; some few, unfortunately, are not. Then too there is the fellow who is overlooked in the shuffle and scramble. He may feel aggrieved, with or without reason. Carefulness of choice and fairness is urged; cliques and obvious discrimination are reprehensible. The University suffers, as does the organization; the honors are empty.

A Word of Warning

JUST a word of warning. Whom the gods wish to destroy they first make happy. We were fortunate to receive Room 214 as a smoking room again last year. Other departments have not this privilege; in fact room shortage throughout the University was so acute that only considerable entreaty obtained for us the use of the room. It was well furnished, and neatly kept, in spite of the fact that it was in almost constant use.

There is a change this year. Rents and tears appear in the chairs and are deliberately and criminally helped along. The floor is used as a cuspidor; cigarette butts and ashes are scattered everywhere. We deserve to lose our smoking room, and we will, if the conduct of a certain large group of fellows does not change immediately. Freshmen do not realize what the room means to us perhaps, but upper classmen certainly do. Let's get together and see that no further complaint will be forthcoming. Reprimand a fellow if you see him offending; if he persists a little force will go a long way. Students from other departments may be the wrongdoers—let them understand that we appreciate this privilege to the extent of seeing that we are going to keep it.

Too Busy

IF YOU work hard and work long your capacity for work is increased. What seemed difficult becomes easy and you seek new worlds of labor to conquer. As a freshman your roster staggered you. Where, you asked, were you to find time to indulge yourself in activities and athletics, to see some of that much discussed "college life", to take things easy and enjoy yourself? It couldn't be done, you said. But as sophomores and juniors, and later as seniors, you looked around and saw that certain of your classmates had achieved fame with the pen and sword, to others had come notoriety from plunges into politics; engineers captained teams, cavorted in Mask and Wig or strutted through more seriously inclined dramatics, helped cover a goodly portion of the paper consumed by campus publications. All this with but little concession to the time their studies demand.

The answer to how did they do it is easy. They are not profligates of time, they put every hour and minute to some use. They plan carefully, figure just how much they can do, and do it. Engineers as a group are well represented in every field of University endeavor. More so, we venture, than any other department, in proportion to their numbers. You don't have to be a grind, just because you're an Engineer.

The Engineer's Show

DON'T forget the Engineers' Show, fellows. December 13, 14 and 15. More is said about it on another page, but we want to impress on you that it is something good and worth while. Engineers may be busy. We have just finished telling you how busy they can be, but in their spare moments they manage to put together a show that is second only to Mask and Wig.

Philadelphia's Water Supply

(Illustrations Courtesy Bureau Municipal Research)

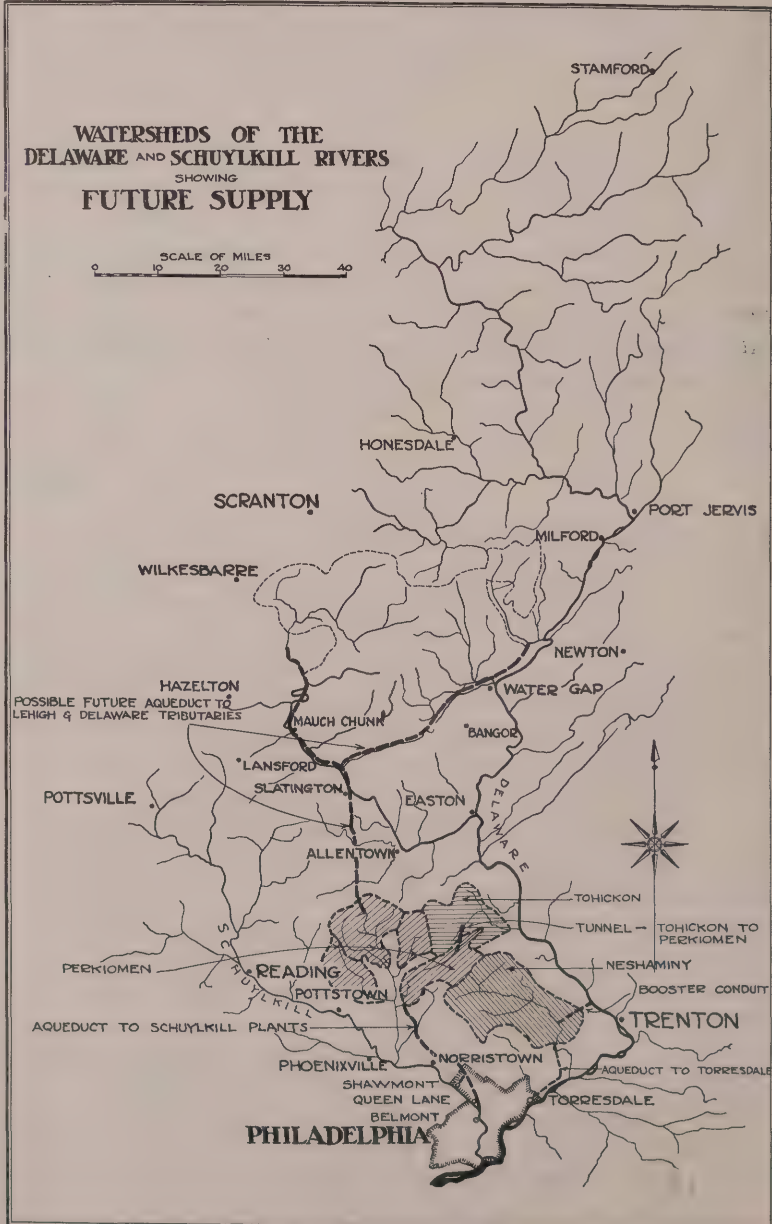
Harry Price, 'Ch. E. '23

Although it was only in 1899 that a commission of engineers was appointed to recommend a future water system for Philadelphia, the present water system constructed according to their specifications is now found to be inadequate and out of date. In almost all of the pumping stations the engines are always overloaded, only emergency repairs can be made and there are no machines in reserve. The reservoirs in different parts of the city have not been overhauled or cleaned since they have been put into operation and they do not have a sufficient capacity to equalize day and night draft. The present sources of water are badly polluted and in the near future will have to be abandoned. The water problem of the city is to secure a better grade of raw water and to increase the capacity of the present system so as to enable it to take care of the future population.

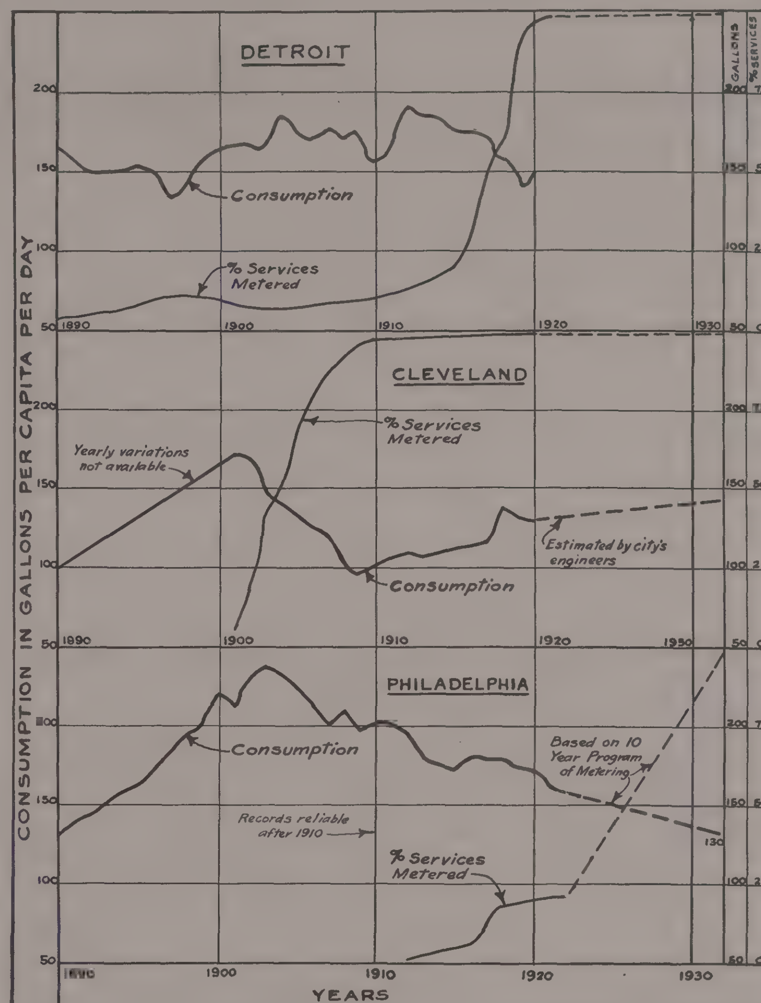
The water supply of Philadelphia is drawn from the Delaware and Schuylkill Rivers at points within the city limits. The Delaware River water is drawn by the Torresdale filters, and supplies more than half the city with water. The Schuylkill River water is draw at three points, at Queen Lane, at Belmont and at Shawmont Ave., Roxborough. The supply of the Schuylkill is regulated by means of the Flat Rock and Fairmount Dams. In all the city filtration plants, with the exception of Roxborough, which is only provided with slow sand filters, the water is run through both rapid and slow sand filters, sterilized with chlorine, and then sent into the mains.

In order to improve the quality of Schuylkill water and to improve Fairmount Park the city has constructed a huge intercepting sewer, which collects the discharge of mains draining northwestern Philadelphia, Roxborough, and Manayunk, and discharges it into the river at a point below Fairmount Dam. This converts the lower part of the river into an open sewer, and this is the sort of thing which causes pollution of the water for cities farther down along the river.

The present program considers the needs of Philadelphia for the next fifty years. The average daily consumption per capita in 1919 was approximately 170 gallons. The present population of Philadelphia is 1,850,000 and it is estimated that in 1970 it will be 3,400,000. At the present consumption of 170 gallons per capita, the total consumption in 1970 would be 600 millions of gallons per day, but with metering the per capita consumption would fall to 130 and the total consumption to under 500 millions of gallons. This volume would suffice for the next fifty years.



There is considerable wastage and leakage of water in Philadelphia as shown by the difference in per capita consumption with and without metering. Figure II shows what the cities of Detroit and Cleveland have done in reducing the per capita consumption by 100 per cent. metering. These curves were plotted so as to eliminate all local variations. Metering is not only the fairer and more logical method of selling water, but it enables the city to check up on the wastage and leakage in its own mains. The wholesale metering of private homes, apartments and office buildings, would have to be stretched over a period of several years; the greater number of manufacturers have their water supply already metered.



In addition to the mechanical problem of increasing the capacity of the city system, comes the problem of obtaining better raw water. Although the river water is seriously polluted the city has in the past been furnishing a high grade of water and amount of typhoid fever due to impurities in the water has been reduced to a negligible quantity.

As the population along the upper Schuylkill and Delaware Rivers continues to increase, and the good old American habit of dumping your sewage on your next door neighbor still remains, it will only be a question of time when raw water from local sources will be of such a poor grade that other sources will have to be found. At the present time unpleasant tastes and odours often occur in Schuylkill water due to excessive pollution and insufficient aeration.

Although sources as the Susquehanna above the Maryland State line, and ground water supply in southern Philadelphia have been proposed, the first would be too expensive, and the second has not been found satisfactory. The most logical place to go, would be to the combined water-sheds of the Perkiomen, Tohicon and Neshaminy Creeks supplementing this later if necessary by aqueducts along the upper Delaware or Lehigh Rivers or from the Delaware River above Trenton at Point Pleasant. The first creek empties into the Schuylkill River, and the other two run into the Delaware. The approximate area covered by their water sheds is shown. These water sheds drain for the most part sparsely settled areas and a few towns as Doylestown and Quakertown. The water obtained from these streams could be allowed to flow by gravity to municipal filter beds in the city. The entire output of these streams would have to be taken to supply 500 millions of gallons.

Although the city has just doubled the capacity of the Queen Lane filters, it has made all improvements so slowly that they are insufficient when they are completed. It is probable the fifty years will be nearly up before the city considers making the necessary improvements to place the water system on a basis to take care of the consumption at that time.

Professor Charles H. Warren was elected Dean of the Sheffield Scientific School at a meeting held by the Yale Corporation in June. Professor Warren is Yale '96 S. and has been a member of the faculty at M. I. T. since graduation. He has done considerable consulting work in mining and chemistry and has also carried on a large amount of research work of a purely scientific character. We extend our congratulations to Yale on the appointment of Professor Warren to this important post.

The Suction Line

HOW LONG SUCTION REDUCES COMPRESSOR CAPACITY

(Illustrations Courtesy of "Power Plant Engineering")

BY AUGUST ULMANN, JR.

(Department of Mechanical Engineering)

LONG suction lines are prone to cause serious trouble in the operation of the refrigeration plant, as it is difficult to insulate the piping so that the suction gas will arrive at the compressor in a saturated state. For a dry compression system we are told by the textbooks that the suction gas should not have more than four or five degrees of superheat to insure dry gas. Excessive superheat rarifies the gas and thus the compressor cannot deliver its full capacity because it takes in a reduced weight of gas on each suction stroke.

The writer recently was called in by a large industrial corporation to consult in regard to some refrigeration equipment in one of their plants that was giving poor results. The refrigeration plant was large and three systems were operated in buildings remote from the compressor plant. The largest system consisted of three vertical, high-speed compressors, motor-driven, of 575 tons refrigeration combined capacity. These machines were used to furnish refrigeration for cooling jacket water down to about 32 degrees F. The cold water was pumped from tanks in a cold room to a building about 100 feet distant and used in the water-jackets of four batteries of nitrators. It was not possible to use brine as during part of the nitration the jacket water was heated to about 150 degrees F. During this part of the operation the hot water was discharged to the sewer and city water at 60 degrees F. was added to make up the loss. This method of operation saved a large amount of refrigeration that would have had to have been expended if a closed brine circulation system had been used. The system worked well but needed careful operation to get the best results.

A second system consisted of a horizontal, motor-driven compressor of 25 tons refrigeration capacity, cooling brine which was pumped to a building about 150 feet distant, through a system of closed jackets on a battery of crystallizing pans. This installation had no special features and worked satisfactorily.

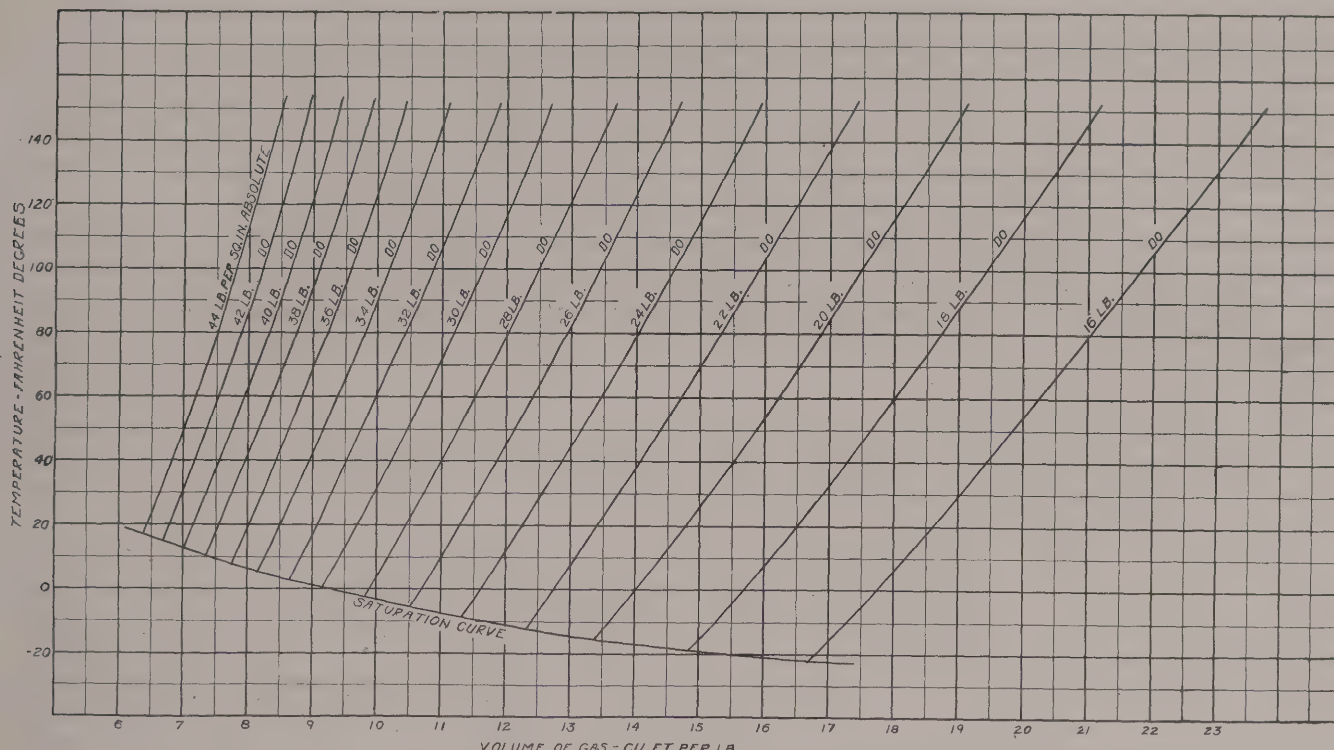
The third system, which was the one giving trouble, consisted of a horizontal, motor-driven compressor of 15 tons refrigeration capacity pumping liquor to a remote direct expansion system. The liquor left the condensers and traveled through 565 feet of 1-inch pipe to four cool rooms on the third floor of a distant building. The expanded gas was returned through an equal length of 2-inch pipe and both lines were not insulated. This was particularly bad as they were exposed to the weather 20 feet above ground on a pole line.

The question immediately came up as to why this suction line was not insulated and the writer was informed that the loss due to this condition, only 3 per cent, was so small that it would not pay to insulate it. They had come to the conclusion that the direct expansion system as installed could not give results and intended to substitute a flooded system in order to overcome their difficulties. It will be of interest to recapitulate the calculations that finally convinced the management of this error.

First the installation was checked as a whole to be sure that it was properly designed. The condensers were ample and the coils in the cool rooms were also large enough. The liquor to be crystallized was fed into the pans in the cool rooms very hot, about 90 degrees C., and it had been found advisable to allow the doors on a recently charged room to stand open for about 6 hours to allow the liquor to cool down to atmospheric temperature before applying the refrigeration. The rooms were well constructed and no fault could be found with the insulation.

The rooms were rotated, a freshly charged room being put on each day. Thus each day the system had to cool down but one room, keep two rooms cold and the fourth room was open with the expansion valve shut off, while the crystal was withdrawn and the pans recharged. The cycle of operation could not be bettered, as it imposed a very uniform load upon the compressor. A calculation on this basis indicated that the compressor should be more than ample, but the facts showed that it was unable to produce an adequate result.

With the capacity available it was calculated that the system should be able to hold two cold rooms at 32 degrees F. and cool down the fresh room in 6 hours, maintaining a suction pressure of about 27 pounds per sq. inch. Actually, during the day it was almost impossible to maintain an adequate suction pressure as it ran between 40 and 50 lb. per sq. inch and it was necessary to shut the expansion valves on the two cold rooms in order to maintain even that pressure. No appreciable gain could be made in cooling the hot room until night came and then it was possible to open the expansion



valves on the two cold rooms and gradually reduce the suction pressure to about 33 lb. per sq. inch. In the morning, again, when a fresh room was closed up and put on the system all the temperatures began to rise and the operators had to begin again fighting to obtain a suction pressure low enough to produce the required temperatures.

As there was no use in attempting to operate at such a high suction pressure as it would not produce the temperatures desired, we set the expansion valves so as to obtain a suction pressure of about 30 lb. per sq. in and took readings which averaged as follows:

Test 8 a. m. to 5 p. m.	9 hr.
Average suction pressure	29 lb. gage
Average discharge pressure	190 lb. gage
Ave. temp. suction gas leaving cool rooms	19 deg. F.
Ave. temp. suction gas at compressor	108 deg. F.
Air temp. in shade	90 deg. F.
Air temp. in sun near suction line	115 deg. F.

It was hard to maintain the suction pressure at 30 lb. per sq. in. and the refrigeration accomplished was entirely inadequate as the two cold rooms were shut off and the hot room dropped only 40 deg. during the test (from 90 to 50 deg. F.). The frost on the suction line showed only where the piping was protected by the process building and the balance of the line was so warm that it did not even sweat.

The temperature of the suction gas, 108 deg. F., indicated a superheat of

108 deg. − 16.4 deg. = 91.6 deg.

16.4 deg. being the temperature of saturated gas at 29 lb. per sq. in. gage.

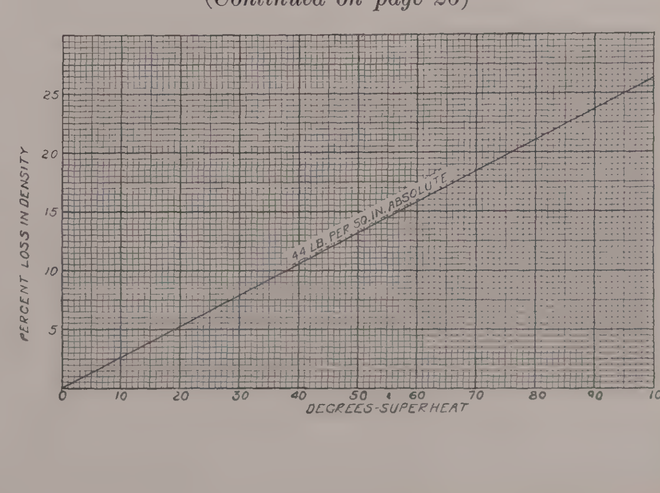
The volume of saturated gas per lb. at 29 lb. per sq. in. gage is 6.38 cu. ft. The volume of the superheated gas per pound at the observed temperature and pressure is 7.92 cu. ft. These values are taken from the curve, Fig. 1, plotted from a standard table of the properties of ammonia gas. The per cent. increase in the volume of 1 lb. of ammonia gas due to the superheat is

$(7.92 - 6.38) \div 6.38 \times 100 = 24.1$ per cent.

thus the compressor, running at constant speed, could compress 75.9 per cent. of the weight of ammonia gas which it would normally handle were the suction gas saturated.

The loss due to the heat added in the long uncovered suction line was calculated as follows: The total heat of 1 lb. of saturated gas at 29 lb. per sq. in. gage is

(*Continued on page 26*)



Guide Posts for The Chemical Graduate

John N. Hans, Ch., '10

Director of Industrial Chemical Laboratory, Harrison Works, E. I. Dupont de Nemours and Co.

(*Interviewed by W. V. Jones, Ch.E., '24*)

Editor's Note—*What Mr. Hans has to say is well worth while; naturally his contacts are chiefly with chemists and chemical engineers, but this is good, sound advice for all of us.*

WHAT are the prospects in the field of Chemistry? Forecasting the future by the attainments of the past ten or twenty years, Chemistry has a wonderful field in view, but when the average young man in college asks what are the prospects in Chemistry, he means what are the chances of getting a good paying job as a Chemist or Chemical Engineer. My answer to that is that your chances are just as good in this line as in any other line. Chemists and Chemical Engineers are holding down high salaried positions, but not solely because they have had a Chemist's training. They are where they are because they possess the qualities that fit them for the positions they fill. Undoubtedly it was because they were Chemists that they were given their opportunity to demonstrate their fitness; because a college course gives a man an education and training that gains a hearing for him when he goes out into the world to earn his living.

The Chemist is placed on the pay-roll at the foot of the ladder, and after that it is up to him. He may eventually land a big paying job, but it will be because he has something else besides a knowledge of Chemistry.

As a routine Chemist in an industrial laboratory the salary will not be commensurate with the time and money spent in his education. This class of work is more in line of manual labor, and any young boy of reasonable intelligence can be trained in a short while to do routine work. Hence, why employ a college graduate? Largely because it is from the chemically trained men that a company expects to draw its executives, and if you do not develop qualities requisite for any of the higher paying positions, such as Superintendent, Sales Manager or President of a chemical concern, it is safe to say that he would not fare any better in any other line.

What are the requisites for a college graduate?

First of all he must be able to answer all kinds of fool questions asked by the layman: if he cannot "he is a bum Chemist" in the eyes of the questioner. Some inquisitive person is always asking What's good to remove ink from a handkerchief? What can I do to polish silverware and prevent it from tarnishing? What can I use to polish the foot treads of my automobile? Can you tell me if there is any wood alcohol in this stuff? and so on ad finitum, ad nauseum.

When the non-technical men on the plant lay down their barrage, it is well to have a plentiful supply of tact on hand.

First and foremost, the employer in hiring a Chemist for routine work expects to get a man who knows his subject, and is accurate, speedy and able to plan his work so as to get the maximum number of analyses out each day. I have seen men run their legs off and still do 50 per cent. less work than a man who used his head more and his feet less. After that an employer expects the new man to develop qualities that will enable him to get ahead when the opportunity presents itself. One of the largest chemical manufacturing concerns in the country tells the prospective employer that they are after men who are *Aggressive* (who insist on results and have the physical and mental qualities to produce them), *Initiative* (who will help to keep the business in the lead), *Loyal* (recognizing the mutuality of interests and seeking always to conserve the interests of the company), *Systematic* (systematizing his own work and religiously following the system in effect throughout the company), *Obedient* (a man who cannot obey the orders of his superior is not competent to be an executive himself), *Honest, Courageous* (gladly accepting responsibility and possessing the courage of his convictions), *Sincere, Resourceful* (undismayed by temporary setbacks and with the patience to overcome obstacles), *Co-operative* (open to suggestions and eager to try any new idea that affords a possible advantage to the company). This looks like an imposing list, but if we stop

to analyze it, we will find that they are qualities which we expect every man to possess who aspires to get ahead in an organization.

A man who has all of the above will of course be alert and have a sense of proportion. Dr. Shinn used to tell a story of two Chemists fresh from college employed the same day, who were told by the plant superintendent that he would have nothing definite for them to do for a few weeks, but that in the meantime they were free to come and go as they wished. One man was pleased at the "cinch" he had, and the plant saw practically nothing of him for two weeks. The other man also was pleased, but, because, being given the run of the plant, he had an opportunity to learn something, and he spent his entire time on the plant. At the end of two weeks the superintendent called both men before him, and told them that unfortunately he would be able to retain only one man. He then asked each man what he had done for the two weeks. You can judge for yourself which one was retained. The hero of the story was a young man who had developed a new process in the laboratory. The superintendent installed the necessary equipment for work scale operation, and placed our young hero in charge. This youth took his paper and pencil and figured that it would require 453,276.1892 grams of raw material per charge. He weighed 453,000 grams on a track scale, 200 grams on a torsion balance, and the remainder on an analytical balance.

What must the college graduate expect and what attitude must he take?

First of all, he must work, and, from his point of view, give more than he gets. Most chemical manufacturing concerns run day and night in normal times. Where the laboratory maintains a day force only, it is sometimes necessary for the Chemist to work overtime: this may or may not mean extra pay, it usually does not. Show the boss that you are a good soldier and can accept responsibility your work entails by not "crabbing" about staying late.

A graduate Chemist, two years out of college, told me on one occasion that he could not stay overtime to do some necessary work unless he was paid for it. The plant Chemist is no better than the plant manager, who is responsible for the proper running of the plant for 24 hours a day and 365 days a year. His responsibility does not begin at 8 A. M. or cease at 5 P. M. He cannot shift the responsibility by saying "that happened at night when I was not here."

When you are assigned a certain class of chemical work, be eager to accept the responsibility for getting the results out in time. Authority will eventually come to the man who can accept responsibility, and you will never become the head of the concern unless you show that you have the qualities for the position.

Never forget that you want a better position than the one you occupy, but in the meantime do the work assigned to you and more if possible, and do it better than it has ever been done before. I have seen men spend so much time telling every one how well they could fill the shoes of the one higher up, that they did not have time to fill their own shoes. While you are holding down your job, learn as much as you can about the next job, so that you will be ready when the time comes. Become familiar with plant operations so that you may be able to grasp the opportunity of getting out into the plant when it presents itself. Some men give the boss the impression that they are too ambitious, and are forever ramming their hopes and ambitions down the boss's throat. That is fatal, if he happens to have a weak stomach. The chances are that he may be willing to consider you a candidate for advancement when the opportunity affords itself, but obviously he cannot be expected to fire himself so you may have a job.

Finally recall how you regarded the boys in the entering class when you were a senior in Prep school, and how, when you were a high and mighty senior in college you looked down on the greenest of the green freshmen, and remember that the college graduate is only a freshman in the university of the world.

Should he locate with a large corporation?

That is too much of a question for me to answer definitely. In the main it depends on the company and the company's policies and not on the size. Many claim that the right man can rise quicker in the smaller company. On the other hand it is claimed that the opportunities are greater and that the good jobs pay better in the larger company. Each man must size up the possibilities in the company with which he becomes associated and decide this question for himself.

Does he select his field, or just naturally fall into it?

I should say that this was more a matter of chance than one of choice, especially when a man is seeking a position. Once a man becomes associated with a certain industry and gains experience along that line, he usually sticks to that field, although not necessarily with the same company.

Did you know that the standing army maintained by the white ants of Ceylon practices a sort of chemical warfare against its insect enemies? The white ants squirt a secretion in the faces of other ants which is said to drive them crazy.

Broadening the Engineers' Course

R. H. Laird, Jr., C. E. '23

THE question has often been raised as to whether it is worth while for an engineering student to study such subjects as psychology, sociology, accounting, and similar subjects which are not strictly pertaining to the science of engineering. There is something to be said for each side of the question. From the undergraduate's point of view any addition to his work is not welcomed. It would be still less welcome if it added a year to his time in the University, even though he might gain by it in the end. The extra year might be avoided by not going into engineering subjects as deeply as at present. That is to say, if the fundamental principles underlying engineering work were stressed thoroughly without spending so much time on the details of the subject, more time would be left to devote to the study of the engineer's relation to his fellow man.

This relationship is important if an engineer is to be successful. For example, a recent issue of the *Engineering News-Record* mentions the problem of the engineers in charge of the Miami Conservacy Project in Ohio in presenting their plans to seventy thousand land owners and getting their approval of a scheme which would ultimately cost these land owners a total of thirty million dollars. To put across such a program meant a careful study of the psychological effect of various ways of presenting the plans. This study had to be from an engineering point of view on account of the nature of the problem. The great success of the engineers' plans indicates how thoroughly they understood the underlying principles of psychology and sociology. These engineers are big men in their field, and they have become big by reason of their knowledge of how to put their own plans across to a public ignorant of the technical features of the plans.

This, and similar incidents, would indicate that an engineer to be successful must have a knowledge of other things aside from his own profession. We have mentioned psychology and sociology because they bear more directly on the relation of man to man, and hence are of value in enabling an engineer to get a better contact with his clients.

An engineer is a salesman just as surely as a storekeeper is. It is true that his methods are different, for he is selling something entirely different from automobiles or real estate. He is selling something intangible, unmeasurable, namely, his services and ability. Consequently, the more he knows about human nature, the better off he is, and the more successful he will become.

It has often been said that more business training would be helpful to an engineer. By that is meant a study of economics, business law, accounting, finance, geography and industry, commerce and transportation, and others. Obviously, some of these courses are more important than others. The University has recognized this, and has given us courses in economics and business law. But these alone are not sufficient to give a student a knowledge of the fundamentals of business administration. The problems of accounting and, more particularly, finance, are of great importance to an engineer. No big undertaking can be handled without coming into contact with these two subjects, and the more the engineer knows about them the better able he is to make the plans and direct the work. In public works, such as municipal and state work, the method of financing the project is of prime importance, for without a satisfactory financial program the project fails, and the engineer is out of a job. This is also true of private projects, but not to so great an extent, for, in this case, stock promoters have sold stock, and gathered in sufficient capital to make a start before the engineer is consulted.

A study of certain phases of Geography and Industry would be of great help in the study of the sources of supply and their bearing on the production of goods in a given locality.

Finally, great specialization is an economically unsound principle. The broad-minded individual, with a general knowledge of many fields, and a specific knowledge of one, is of far greater benefit to society than the highly trained, narrow-minded specialist, who cannot see beyond his own line of work.

Principles and Applications of the Alinement Diagram

By R. A. Krauss, E. E. '24

LET three lines X, Y, Z, be drawn in a plane, parallel, and equally spaced. (See Fig. 1.) Let any two transversals be drawn, and let the intercepted segments be x', y', z'. Then y' is the arithmetical mean of x' and z', or

$$y' = \frac{x' + z'}{2}$$

This principle is made use of in this way—

Scales are placed on the lines X, Y, Z. Now if the scales be in arithmetical progression, and equal on all three lines, with the zero points on one transversal, any other transversal will determine a point on each line such that, calling the scale readings at these points x, y, z,

$$y = \frac{x + z}{2} \text{ or } 2y = x + z$$

Now if the Y-scale divisions be made half as great as the divisions on the other two lines, the scale reading at y will be

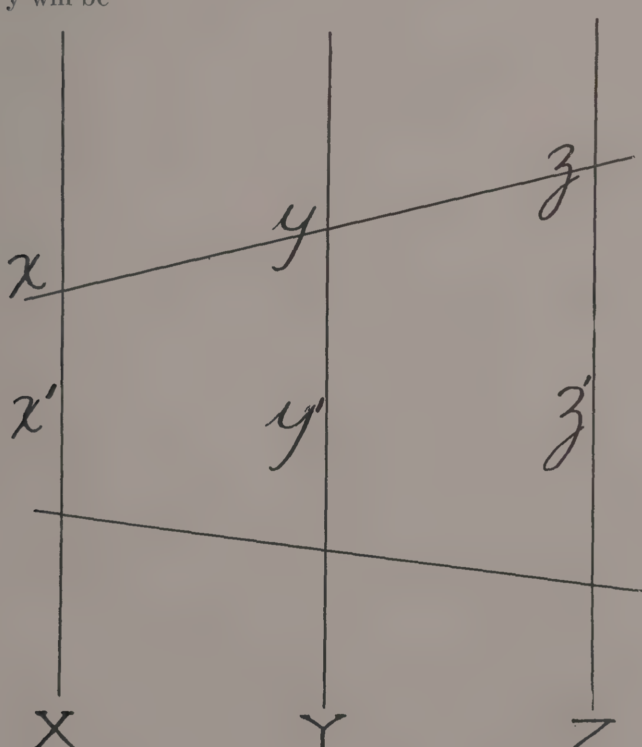


Fig. 1

$$y = x + z$$

which is the general formula of the simple case.

Now if any of the scales be inverted, the effect is to change the sign of the corresponding terms in the formula. If any scale be moved up or down, the effect is to add to or subtract from the corresponding variable a constant equal to the distance in scale divisions which the scale has been moved. And if any scale be made, say, half the length as previously determined, the effect will be to multiply the corresponding quantity in the equation by two, and similarly for other factors. Finally, by recalibrating the scales, any function of each variable is placed in the formula instead of the variable itself. This makes possible the addition or subtraction of any two independent variables. The general equation expressing this is

$$f(y) = f(x) + f(z)$$

By applying this formula to logarithms, or by making the original scales in geometrical progression, the effect is to multiply or divide instead of adding or subtracting. Suppose we start with the scales equal except for the middle one which is half as large as the other two, and with the three points marked 1 in a straight line; then inverting a scale divides by the corresponding variable instead of multiplying, moving a scale up or down multiplies or divides that variable by a constant, and changing the size of a scale changes to a root or power of the variable corresponding to the ratio of the new scale to the old. Also, by recalibrating the scales, any function of the variable may be placed in the formula instead of the variable itself. The general equation is then

$$f(y) = f(x) \times f(z)$$

which could have been deduced from the former equation by making the functions in an exponential form.

In practice the method easiest to use in most cases is to make skeleton scales in arithmetical or geometrical progression according as the operation involved is addition or multiplication and then moving or recalibrating the scales to fit the particular equation involved.

When more than two independent variables occur, they can be combined first two at a time, making the third line the resultant instead of the second by merely inverting the first line. This result is combined with another variable to give another resultant and so on

until all of the variables are brought in and the final result is reached. In this case the intermediate or preliminary results need not usually be known and the corresponding lines left without scales, unless the processes are not all of the same kind, *e.g.* if the formula combines a multiplication of two of the variables with the addition of a third. In this case the scales on one line would be geometrical and in the next arithmetical which would not give a correct result. In this case, and in the event of odd or complex functions of any of the variables occurring, special means must be resorted to.

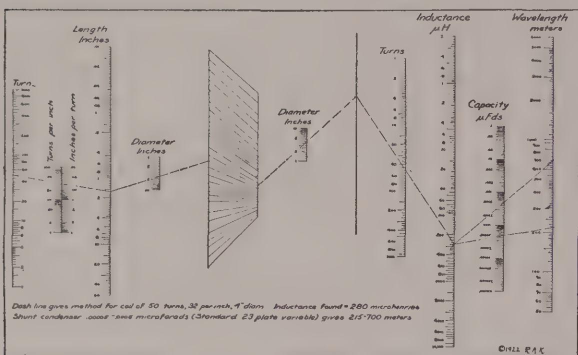


Fig. 2

The author has recently constructed an alinement diagram which brings in several of these principles. This chart is shown reduced in Fig. 2. The computation involved is that of the self-inductance of an air-core single-layer solenoid of the type universally used in radio receiving circuits.

The formula for this computation, after being simplified became

$$L = \frac{4\,\Pi^2\, a n^2\, K}{1000}$$

where L = self-inductance in microhenries
a = radius in centimeters
n = total number of turns

$$K = f\frac{(2a)}{b}$$

in which b = length in centimeters

The factor K is an empirical function and can not be expressed in a simple mathematical equation. Special means was resorted to in this connection as will be shown later.

Referring to the formula, it is seen that the three necessary known quantities are the radius, the number of turns and the length. Since K is difficult to handle, we shall find its value first.

Referring to Fig. 2, the third and fourth lines are the length and diameter respectively. The first and second lines, in conjunction with the third, are used to find the length or number of turns when one of these quantities is unknown, by means of their ratio which is the pitch of the winding. The fifth line gives in effect the ratio of the diameter to the length which is independent of the units, provided both are expressed in the same system. The sixth line was originally scaled for values of K, and the guidelines drawn between corresponding values on the fifth and sixth lines. The seventh line represents the radius in centimeters but is calibrated in inches of diameter to simplify measurements. The eighth line gives the value of Ka but is not scaled since this quantity has no significance by itself. The ninth line represents the number of turns, and the scale being twice its normal size, the result on the tenth line is an^2 K. The factor $\frac{4\Pi^2}{1000}$ brought in by the calibration makes the scale read directly in microhenries.

To get the natural wave-length of a circuit containing this inductance and a known capacity, we make use of the formula

$$\lambda^2 = 3{,}000{,}000\ LC$$

where λ = wave-length in meters
C = capacity in microfarads

The capacity scale is half the size of the inductance scale because it is the middle line, and the wave-length scale is twice the size of the inductance scale because the square of the wave-length appears in the formula. The calibration brings in the factor 3,000,000, the scale reading directly in meters.

This chart as published by Lefax is 6 in. x 9 in. and when used with care will give a result which is in error less than 1 per cent. This is quite sufficiently accurate for all practical purposes. It is very easy to use and is a very effective time-saver in calculation. Using a slide-rule and a table of values of K, having measured the dimensions of the coil in inches, the computation will require not less than five minutes to carry out, whereas with the chart it can be done easily in less than one minute. When several coils, or coils having taps, are to be calibrated, the saving in time becomes considerable. In designing a coil to have a given inductance, since the formula cannot be worked backwards on account of the presence of the factor K in the equation the method is to decide upon two of the dimensions and to estimate the third, then work out the inductance using the chart, varying the assigned values until a result is secured which is consistent with the desired dimensions. In this case also very much time is saved. The chart moreover is not subject to errors in placing the decimal point as is a slide-rule. For these reasons it is practically indispensable to anyone who builds radio inductances.

Engineering and Milk

Clarence Rife, M.E., '24

EVERY student in the Engineering School is familiar with the milk shake as a handy thing with which to satisfy an inner craving, ordinarily calling for a square meal, but getting the hasty substitute and the well-known excuse of not having enough time. Very few people, however, think of milk as the highly specialized product of one of our country's largest industries, a product used by every man, woman and child. The extent of the general knowledge of this product seems to consist of the facts that a cow furnishes the milk, and that a milkman waits until four A.M. to deliver it, so that his noisy activity will be sure to attract attention. In some communities there is still some doubt about the first of these facts, the milk dealer getting credit for the whole thing.

A modern dairy farm boasts of many labor-saving and ingenious machines and systems for preparing the raw material for shipment to the city. Then too, the problem of getting the milk from the cow to the consumer in the shortest possible time is vital and primarily a problem of engineering. The familiar and unsanitary milk can has been replaced by a seamless glass lined steel tank, possessing, aside from the sanitary features, the technical advantages of increased capacity, decreased surface in contact, and a saving in time and labor required in loading and unloading. These tanks are usually emptied by steam-driven pumps, but there has been devised a compressed air system consisting of a motor-driven Air Compressor, special receivers, cooling coils and unique filters. This system has proved quicker and cheaper than the use of steam pumps. The milk is forced into storage tanks, also glass lined, and here the Plant Engineer must assume the responsibility of caring for it. A brine jacket is used to keep the temperature at forty degrees and a motor-driven Agitator must be kept running in order that the tester may be able to make an accurate standardization.

The man who takes control of the still raw material must be, in addition to an expert and well-trained dairyman, a man capable of operating and caring for complicated machinery and confusing systems of steam, water brine, ammonia, and sanitary milk lines. After being standardized and tested, the milk is pumped through efficient clarifiers whose results clearly show their necessity. The next step is Pasteurization, requiring absolute control of the milk every second, and accomplished by means of automatic pressure and temperature regulators. After Pasteurization, the process is completed in a Holder which must maintain a constant temperature for thirty minutes, and then immediately discharge its contents, all requiring careful temperature regulation and accurate timing.

The next step is to cool the milk preparatory to bottling, over direct expansion ammonia coils. An efficient use of the cold raw milk is made in a regenerative cooling system. This immense cooler must bring the temperature from 148 degrees to 35 degrees. All of the temperature changes up to this point in the operation are checked by accurate recording thermometers; there must be no guess work. Every step has to meet the requirements of state and city inspectors, and the final judgment of the consumer.

Before the milk can be put in bottles, costly machinery is required to wash and sterilize every glass container.

The filling and capping machinery is the outcome of years of experience and thoughtful design. The Engineer who plans such equipment, has always to keep in mind and provide for sanitary as well as mechanical features.

From the bottle filling department, the bottles of milk are carried away by means of moving conveyors into a cold storage room, where they are kept at a low temperature until loaded for delivery in the morning.

The total lapse of time from the farm to the cold storage room is about seven hours.

The heart of the plant and of necessity the department requiring most of the engineering ability, is the power plant. Boilers, steam-driven ammonia compressors, motor-generators, and generators all provide interest and occupation enough for any Engineer.

In this business, profits are so small, competition so keen, and the field so big, that it offers a splendid opportunity to engineering students to apply their technical training to the further development of an ever growing industry and to their own advantage.

Priestley Club Lecture

DR. EDGAR FAHS SMITH TALKS ON LIFE AND WORKS
OF EARLY CHEMIST—FINE COLLECTIONS SHOWN

ON the afternoon of November third, members of the Priestley Club and a number of guests were granted the opportunity of hearing Dr. Edgar Fahs Smith talk on what, perhaps, is his favorite topic—the life and accomplishments of Joseph Priestley. The talk was the first of the season, but the auditorium of Harrison Laboratory was crowded to capacity.

Dr. Smith first told how, after numerous failures as a dissenting clergyman, Priestley became interested in experimental chemistry in the little academy at Birmingham; how, on the morning of August 1, 1774, he chanced to try the effect of a burning-glass on mercuric oxide, and how, for months thereafter, he diligently studied "dephlogisticated air," which, he stated, was healthier than ordinary air. Thus was oxygen discovered.

This, however, was not his only great work in chemistry. He first prepared hydrogen sulphide, gaseous hydrogen chloride, fluosilicic acid and nitrous and nitric oxides. He was the first to recognize ammonia, and he came very close to the discovery of nitrogen.

In 1791, when he was pursuing some investigations with carbon dioxide, the unpopularity occasioned by his former attitude as a dissenter, came to a head and he had to go in hiding from infuriated mobs. He later came out, but such was the feeling against him that it transferred itself to his family, and one of his sons was forced to dissolve a very successful business partnership on account of it.

Joseph Priestley.

Shortly after, his sons came to America, and in 1794, they were followed by Dr. and Mrs. Priestley.

He was warmly welcomed in New York by a number of societies; came to Philadelphia and was again enthusiastically welcomed. Receiving more adulation than he liked, he moved on to Reading, thence to Hamburg and, finally, to Northumberland, where he made his permanent home. Philadelphia he criticized as being too hot and too expensive, but he visited on several occasions, staying each time from four to eight weeks.

It is known that Dr. Franklin and Dr. Priestley were warm friends, and it was due to the former's influence that Priestley wrote his "History of Electricity." An interesting reference is made in the book to Ebenezer Kinnersley, who taught at the University Pennsylvania at that time. A number of other books are included in the works of this remarkable man—on Grammar, Optics, and Religion.

His laboratory at Northumberland was ready for use in 1798, so that he was able to recommence his experimental work. At this place, he recognized carbon monoxide, and explained the diffusion of gases. He prepared potassium silicate and gave a method for pre-

(*Continued on page 27*)

TOWNE TOPICS

MEN ABOUT TOWNE CLUB

The Engineers' Show for 1922, the fourth of the Annual productions of the Men About Towne Club, will be presented to the expectant public on the evenings of December 13, 14 and 15, in the auditorium of the Engineering Building. "Laying Letty Low, or the Tale of the Yellow Dog" is the title of this year's offering and from all indications it will be a record breaker. The book is by Manz, E. E. '23, lyrics by Robinson, and music by Robinson, Arthur and Fry. The cast and choruses have been working strenuously for six weeks, meeting during the Thanksgiving holiday, and have attained a high degree of excellence. Jarden and Parker in feminine roles and Lipp and Jenkins carry the brunt of the comedy, and show special promise.

Clubmen of recent years have rallied to make this year's production the best ever. "Bill" Marshall, president of two years ago, and Hubbard, another Mask and Wig star are coaching the dancing chorus, which is unusually graceful and agile. The cast is in charge of Schaefer, the hero of last year's "All for Love," and "Johnny" Clothier is directing the glee chorus. A well trained orchestra of our best musicians assists in putting over the musical numbers.

The original music has always been a feature and this year the innovation of selling printed scores will be tried. The club is going to considerable expense in having these scores printed and will sell them at less than cost, fifty cents each. It is hoped and expected that the sale will be large, as they are a permanent souvenir of the show, in addition to any musical value they possess.

President Robinson wishes to announce that a special performance will be given before the Engineering Alumni on Saturday night, December 16. An informal supper and business meeting to which all seniors are invited will precede the show. Seniors who have purchased a ticket for any of the three regular performances will also be permitted to see the special performance, which always has many novel and unusual features.

This is the big event of the first term for Towne. Successful productions have brought the club into considerable notice and the show always is and should be eagerly awaited. The whole school should pull for it, for it is a thing to be proud of. No other department puts on a show like this. We say they can't. Help put this across by coming around and applauding, if you're not in the show in some capacity, and by talking about it around the campus. Freshmen and sophomores are particularly urged to get interested.

Lest we forget, a popular campus orchestra will emit dance music until 1 A. M.

Remember the three big nights in December.

CIVIL ENGINEERING SOCIETY NOTES

The senior class has taken several interesting trips this year in and around the city.

On October 5th, under the guidance of Mr. Swaab of the Keystone State Construction Co., the Camden end of the new Delaware River bridge was visited.

The new Frankford elevated line was inspected on Oct. 20th. Mr. C. W. Stevens, Secretary of the local chapter of the A. S. C. E., undertook to show the students around.

The bridges of the Schuylkill were visited on Oct. 30. The party was arranged and conducted under the direction of Mr. H. H. Quimbly, Chief Engineer in the Department of City Transit.

The Pencoyd Plant of the American Bridge Co. was visited on November 15 and here the students were given an idea as to how I beams are made.

On November 24, the Society had the opportunity of listening to a very interesting lecture by Mr. J. S. Conway on the subject of the lighthouse service of which he is Deputy Commissioner. He explained to the edification of all the principles of the new radio finder.

CIVIL ENGINEERING NOTES

On November 10th, Dr. Wm. Kendrick Hatt gave an illustrated lecture to both the senior and junior classes in civil engineering. The talk consisted essentially of pointing out the great progress made in road construction, road research and road economics. In conclusion he urged men to think seriously of road building as a possible vocation and especially emphasized the importance of road research.

The second meeting of the Civil Engineering Society was held in conjunction with the Electrical Engineering Society. Mr. J. Dodd, consulting electrical engineer of Philadelphia, was the chief speaker. His talk consisted essentially of pointing out the new and interesting points, featured in the construction of the new Frankford Elevated Trains. The Electrical Engineering Society furnished entertainment in the form of a radio-concert. A combined meeting is a success and more of the same kind should be urged.

The American Institute of Mining and Metallurgical Engineers meet in New York City, February 19th to 21st.

The following lectures will be given at the Engineers' Club in the future:

December 21—Dr. John H. Müller, University of Pennsylvania.
Subject—"Germanium."

January 18—Dr. Julius Steiglitz, University ofChicago, Past President of American Chemical Society.
Subject—"Some problems in the field of Chemistry and Medicine."

February 15—Dr. Charles E. Vanderkleed, Chief Chemist, Cellulose Silk Co., of America.
Subject—"Silk and Artificial Silk."

WHITNEY ENGINEERING SOCIETY

On Friday evening, November 24, a smoker was held in the Engineering building at which time Mr. D. S. Hilborn of the Bell Telephone Co. delivered a very interesting lecture on the "Past and Future Development of Telephone Cable Testing." This was not only of great interest to our men, but also to the Electrical Engineers who were our guests of the evening. Several of the boys helped out with the entertainment which added to the success of the smoker.

The membership drive this year has been much better than in the past years, but it has not quite reached 100 per cent. which is our goal. Membership cards can still be had from and of the committees, namely, Wm. Foley, H. W. Walker, G. R. King, Ralph Van Kleek, Jos. D. Burke, C. O'Toole, J. D. Dorsey, J. M. Hewlett, Jr., Chairman.

Plans are being formulated to petition the American Society of Mechanical Engineers for a Student Chapter at the University of Pennsylvania. Nothing definite has been done along these lines, but within a few months it is hoped that this proposition will be well under way, at which time something more definite can be said in its behalf.

MEETINGS

The American Engineering Council will have their annual meeting in Washington D. C., January 11th and 12th.

The American Society of Heating and Ventilating Engineers have their Annual Meeting January 23d, in New York City, and a later meeting in Washington, D. C., January 24th to 26th.

PENN STUDENTS WIN PRIZES

Beaux Art Medals Awarded in Architectural Competition

The recent Beaux Arts Judgment in New York, gave University of Pennsylvania students two of the four second medals awarded.

Armand D. Carroll, of San Francisco, and Roy F. Larson, of Chicago, seniors in the School of Architecture, submitted the winning drawings. No first medals were given. One second medal was awarded to Carnegie Tech. and another to Yale.

The subject of the competition was a "National Tennis Club." None of the work submitted by Pennsylvania students drew "checks," which, in the parlance of the architect, means none of them were rejected from the competition. First mentions were awarded to Shen Chao, of China; David C. Cleland, of this city; Albert L. Haws, Frederick L. Hutchins, Alfred E. Poor, Robert L. Price, Lee P. Rombotis, Roy Ruhnka, and Henry Johnston Toombs. Second mentions were awarded to Francis W. Baldwin, William E. Willner and Lorenzo S. Young.

The competition was open to all colleges and universities in the United States.

The Stewardson Competition, open to anyone who has lived in the State of Pennsylvania for a year, and carrying a traveling scholarship of $1,000, was also won by University of Pennsylvania men, three of the five coming here.

The American Institute of Electrical Engineers have their Mid-Winter Convention in New York City February 14th to 16th.

Engineering News

M. I. T.'S NEW PRESIDENT

Dr. Samuel W. Stratton, former Physicist and Chief of Metallurgy of the National Bureau of Standards, was recently selected as the new President of the Massachusetts Institute of Technology. In the twenty-one years that he was connected with the bureau as its head he developed it into one of the finest research institutions in the world. He established, to stimulate graduate work at the Bureau, one of the best Graduate Schools of Science in this country. The Bureau is an ideal place to work up an experimental thesis and individual arrangements are made with universities for the procuring of a Doctor's degree.

Under Dr. Stratton's guidance great advances in experimental work will be realized.

SUPER VACUUM TUBE

The largest vacuum tube ever made, has just been developed in the Research Laboratories of the General Electric Company. It is of one million watts capacity (1,000 KW) and is 50 times greater than any tube now in use. The tube weighs 60 pounds. It would light 40,000 25 watt lamps or supply energy to almost 1,500 average homes. The filament is a rod of tungsten so large that if drawn out into filament of the size used in the average electric lamp, it would make 50 miles of filament; or it would make filament for 175,000 such lamps. The light given off during the operation would amount to 40,000 candle power.

The creation of this great unit grew out of a desire to produce tubes for general power purposes, as well as radio, and thus open up the possibility of a new field for the vacuum tube. This development has been in charge of Dr. A. W. Hull, noted for his vacuum tube development work.

$25,000 CHEMICAL PRIZE

Annual Award Offered for the Most Notable Contribution

An announcement was made at the opening meeting of the council of the American Chemical Society that a prize of $25,000 would be given every year to the American who makes the most notable contribution to chemical science.

The award is to be made by a committee of seven, of which Dr. Edgar F. Smith, President of the American Chemical Society, is to be Chairman. The Allied Chemical and Dye Corporation of New York City, through William H. Nichols, offered the prize. The committee members are to have no connection with the corporation.

The council accepted the gift, which is to become operative next year.

A NEW SOLID FUEL: METALDEHYDE

Recently a new fuel has been put out on the market that is of both commercial and chemical interest. There are many types of solid fuels on the market which use as their heat producing medium alcohol dissolved in a non-volatile solvent. Such solvents as agar-agar, collodion and cellulose acetate have been used with some success. However, due to the volatility of the alcohol these fuels must be kept in air-tight vessels.

A Swiss concern, the Usines Electriques of Basel, seems to have solved the problem. The new fuel metaldehyde is a polymer of acetaldehyde which is made in Switzerland thru a synthetic process from Calcium Carbide. It is made by cooling acetaldehyde to a low temperature and then adding dilute sulphuric acid. Metacetaldehyde crystallizes out and can be separated by filtration. Metaldehyde does not melt under (atmospheric) pressure. It starts to sublime without melting between 112 and 115 degrees C. It does not burn itself but the acetaldehyde formed by the heat from the flame burns. This keeps the fuel itself so cool that it is possible to extinguish the flame with the palm of the hand.

Laws licensing engineers and architects who design and supervise the construction of buildings have

been passed in the following states: Arizona, Colorado, Florida, Indiana, Illinois, Iowa, Louisiana, Michigan, Minnesota, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Tennessee, Virginia and West Virginia, a total of 17 states. Similar laws are before the legislatures of Mississippi, Kentucky and South Carolina. There is no licensing law for the protection of the public in the District of Columbia, which might have averted the disaster in Washington last January, when the roof of the Knickerbocker theater failed, killing more than 110 people.

The movement for the enactment of adequate licensing laws for the protection of the public from the activities of dabblers and quacks has been actively supported by the American Association of Engineers, an organization of 24,000 professional engineers. It is to their credit that they are seeking to curb the profession of incompetents.

—*The Rose Techni*.

Pennsylvania Graduate Awarded Grasselli Medal

At a recent meeting of the American Section of the Society of Chemical Industry, Herbert Fulweiler, a graduate of the University of Pennsylvania, was awarded the Grasselli Medal as recognition of a paper on gas problems, which he had delivered some time previously.

This medal is bestowed each year, by the Grasselli Chemical Company, on the chemist who offers the most useful suggestions in applied chemistry. The honor is increased by the fact that the award has been made only twice in the last five years.

Mr. Fulweiler is a Philadelphian. He graduated from the University in 1901 with the degree of B. S. in Chemistry. He worked with the Philadelphia Gas Company and with the U. G. I. for whom he is now Chemical Engineer.

During the war, his work was connected with that of the Ordnance Department. He did valuable work with reference to the production of toluene, developing from his process a by-product which was extensively used as airplane motor fuel. Much of his attention has been devoted to the determination of sulphur compounds in illuminating gas.

Despite former exhaustive studies of the subject, Mr. Fulweiler's work has developed several new fields of investigation in the gas industries. At present, he is working on a system for the identification of hydrocarbons in petroleum oils.

Of the 270 cities in the United States that have the city manager form of government, 45 per cent. have engineers as city managers. In the smaller cities where the manager is in direct charge of all public improvements, furnishing of the water supply, collection and disposal of municipal waste, and protecting life and property against building and fire hazards, an engineer in this position is particularly needed, according to the *Engineering News-Record*.

ALUMNI

Mr. Charles L. Simon, Ch. E. 22, past president of the Men About Towne Club, is now a sales engineer with the Brown Instrument Co., and is located in Pittsburgh.

Francis Q. Thorp, Ch. E. 22, is also connected with the Brown Instrument Co., in the same capacity in Philadelphia.

Harold Fleckenstein is employed in research work at the Brown Instrument Co.

Leonard L. Kalish, Ch. E. 22, is at present connected with the U. S. Patent Office as an examiner.

Ralph Muller, Ch. 22, is studying for his M.S. in Chemistry at Columbia University.

Mr. Charles Foppert, C. E. 22, last year's Circulation Manager, is now located with the Bell Telephone Co. in Philadelphia.

Mr. Russel Chew and Reuben Bender, C. E. 22, are with the McClintic-Marshall Construction Co., in Pottstown.

Mr. C. Kline, C. E. 22, is associated with the Simplex Valve Co., of Philadelphia.

Charles J. Werner is employed with Pfeiffer and Co., of this city.

Mr. Robert Sergersen is chemist with one of the subsidiary companies of the Carnegie Steel Co.

D. M. Stackhouse, '87, is assistant general superintendant of Cambria Steel Co. He is living at 145 Fayette St., Johnstown, Pa.

Ricardo Z. Zimmerman, '16, is with the Salem Lighting Co., Salem, Ohio.

Leslie L. Bamberger, '17, is living at 16 Radcliffe Ave., Providence, R. I.

Leon P. Feustman, '82, is vice president of Worthington Pump and Machinery Corp., offices, 115 Broadway, New York.

Joseph P. Williams, '13, is now living at 3116 W. Penn St., Germantown.

Wm. J. Baxter, '20, is a student engineer with the General Electric Co., and is living at 1348 Union St., Schenectady, New York.

Robert R. Foley, '16, is now living at 151 Fifth Ave., New York.

E. A. Munyan, '14, is with the Allentown-Bethlehem Gas Co.

Charles McAnally, '21, is a student engineer with the Bell Telephone Co., of Pennsylvania.

Allan M. Rife, '20, is assistant chief engineer of the Scott-Powell Dairies, 45th and Parrish Sts., Philadelphia.

Wm. Marshall, '21, is now with the Otis Elevator Co., of Philadelphia.

Wm. Schwem, '20, is branch manager of the Cornell Utilities Co., offices, 135 S. 16th St., Philadelphia.

Walter Irwin, '21, and Alexander Patterson, '21, are now with the United Gas Improvement Co., of Phila.

Harry H. Keller, '20, is representing the Vilter Mfg. Co., of Milwaukee, Wis., offices at 10th and Chestnut Sts., Philadelphia.

Ned Ramsey, '20, is now with the American Gas Co., 7th and Locust Sts., Philadelphia.

Ben V. Schlein, '21, is with Clarence Wunder, Architect and Engineer.

THE SUCTION LINE

(*Continued from page 11*)

542.8 B.t.u. and the total heat at the same pressure with 91.6 deg. F. of superheat is 595.5 B.t.u. Thus the per cent. loss per pound of gas due to this addition of heat is

$$(595.5 - 542.8) \div 542.8 \times 100 = 9.70 \text{ per cent.}$$

This loss in itself is not so large and anybody not familiar with refrigerafion might be led to believe that the system could not be seriously upset by it alone. But the consequent loss in the compressor due to the rarification of the suction gas, shown to be 24.1 per cent, could easily upset the operation of the system and produce the symptoms observed.

From this it can be seen how important it is to have the suction line properly covered to insure saturated gas at the compressor suction. Figure 2 is a plotted curve showing how the per cent. in density of a pound of ammonia gas increases with the superheat. The curve is plotted for one pressure only 29 lb. per sq. in. gage or 44 lb. per sq. in. absolute.

There are further losses in the compressor due to excessively high temperatures which were not calculated for this particular case, but they would be evident to the practiced operator as excessive quantities of oil were required. The cylinder-heads were coated with a carbon deposit and the valves and valve stems suffered badly. When the suction line was covered the system came up to specification and was able to do the work very acceptably.

PRIESTLEY CLUB LECTURE

(*Continued from page 18*)

paring pure nitrogen. He published a number of pamphlets, all full of new discoveries.

Despite his great work, he was never converted from the phlogiston theory, and to his death gave a wrong interpretation to many of his discoveries.

He died in Northumberland in 1804, while quietly reading proof—this greatest pioneer in the history of chemistry and one of the finest thinkers of any age. And it must not be forgotten in passing that he was the establisher of the Unitarian Church.

The meeting closed with an open exhibition of a fine collection of Priestleyana, some loaned, for the day, by Dickinson College, but a great many being the personal property of Dr. Smith. This included a number of books and one manuscript in Priestley's own hand; numerous scientific instruments, microscopic slides, the famous burning-glass, and what was probably the finest piece of all, the balance used by Priestley, in perfect condition. This last is now being copied by the Royal Society of London. His book plate, and an engraving from a life portrait by Stuart are shown.

WILLIAM CREIGHTON, '15, is a member of the faculty of the Architectural School in the University of Pennsylvania.

JOHN V. CALHOUN, '20, is with the Combustion Engineering Corporation, located at 43 Broad Street, New York City. He is now engaged in erection and service work. His home is in Ardmore, Pa., at 45 Wyoming Avenue.

C. M. THOMPSON, '15, is now living in Narberth, Pa., at 306 Prince Avenue.

STUART D. KERR, '17, is with the Cincinnati Chemical Works in St. Bernard, Ohio. He lives in Cincinnati at 11 West Street.

G. E. WAGNER, '19, of 710 S. Phœnix Street, Tulsa, Oklahoma, is connected with the Sinclair Pipe Line Company of Tulsa. He has been in Chicago during the past three months in charge of pipe inspection.

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PORTRAIT OF J. DALTON

BY JOHN LONSDALE

The Quaker *who made* Chemistry a Science

CAVENDISH had shown that two volumes of hydrogen and one of oxygen always combine completely to form water and nothing else. Proust, a Frenchman, had proved that natural and artificial carbonates of copper are always constant in composition.

"There must be some law in this," reasoned Dalton (1766-1844), the Quaker mathematician and school teacher. That law he proceeded to discover by weighing and measuring. He found that each element has a combining weight of its own. To explain this, he evolved his atomic theory — the atoms of each element are all alike in size and weight; hence a combination can occur only in definite proportions.

Dalton's theory was published in 1808. In that same year, Napoleon made his brother, Joseph, king of Spain. This was considered a political event of tremendous importance. But Joseph left no lasting impression, while Dalton, by his discovery, elevated chemistry from a mass of unclassified observations and recipes into a science.

Modern scientists have gone beyond Dalton. They have found the atom to be composed of electrons, minute electrical particles. In the Research Laboratories of the General Electric Company much has been done to make this theory practically applicable so that chemists can actually predict the physical, chemical and electrical properties of compounds yet undiscovered.

In a world of fleeting events the spirit of science and research endures.

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THE TOWNE SCIENTIFIC SCHOOL JOURNAL

C·C·ROTH

THE JOURNAL congratulates Dr. Penniman upon his accession to the Provostship, the duties of which office he has been fulfilling since the resignation of Dr. Smith, two years ago. It is a move that is applauded unanimously by the student body. From their point of view Dr. Penniman *has* been the Provost, and the official recognition of the fact only makes the assurance doub'y sure.

While it is not the Engineers' privilege to have classroom contact with Dr. Penniman, they can fully appreciate the charm of his personality and his sound views on scholastic and student regulation from the all-University assemblies at which he presides. The seniors doubtless remember with pleasure the lecture course in chemistry under Dr. Smith, which we attended as freshmen, and the varied stock of information we acquired there. We honored and respected Dr. Smith, but he always made us feel at ease with his kindly advice and earnest admonitions. Therefore, we envy the fellows who can study under Dr. Penniman. It is another example, an outstanding one this time, of the intangible but invaluable benefits we can derive from associations of this kind.

We wish Dr. Penniman every success, and assure him that he has the respect and obedience of the Engineering student body.

* * *

Write for the Journal

THERE are members of both the undergraduate and alumni bodies who are willing, even anxious, to write articles upon various subjects of scientific interest, depending upon which specific line of work they are interested in, or to which they have ready access.

The TOWNE SCIENTIFIC SCHOOL JOURNAL is your own paper, made for you, and fostered and nurtured by you. If you care to help it to a still higher plane of success, we shall be very grateful indeed. You need not be a heeler to see your article in print, and furthermore, you may be assured that your writings will receive the most courteous and favorable kind of attention. We invite your co-operation, and we feel certain that with it, the ever-increasing popularity of our periodical will be even more augmented. Write for the JOURNAL!

Does This Fit You?

BROTHER ENGINEERS, just park yourselves in front of the Engineering Building right before the periods devoted to the study of languages and list:

"'Lo Bill! Where to? To French? What's the matter, got a quiz? No quiz and you intend to go? You're crazy. Let's cut! The 'Prof' won't know it. Why I've taken fourteen cuts so far and he's only marked me for three."

You've heard that before haven't you? Why of course you have! The language in question may have been German or Spanish and the phraseology slightly different but the context was always a constant.

Listen, you engineers! Why all this antipathy toward the language you are studying? Why this, "Now Bobby, take your cod liver oil and molasses" attitude? Do you think that you are taking a language for your health or mayhap that the faculty has thrust it upon you simply to fill up a few periods? True, we engineers have a roster so filled that oases are very rare and accordingly when our language period comes around we are prone to think that, the subject being unimportant, we can relax. But is it unimportant?

No engineering school is going to burden a student with an unimportant subject. Every engineer should be able to feel fairly confident in one language besides his own. In the modern scientific and business world where competition is so keen, the fellow that gets ahead is the fel ow that gets the jump on the other fellow. And anything that enables you to gain such an advantage is of inestimable value to you. The French, the Germans, and in a lesser degree, the Spanish are continually making great strides in all the sciences and their results are published in their own language long before the English version comes out. Many times discoveries are never published in the English language and untold quantities of vital literature are locked up in foreign language vestments.

Now you engineers, take this to heart. Cut out the "baby stuff" in your attitude toward your language. Of course, no one expects you to be a walking grammar, or to babble or dash off verb conjugations or to speak knowingly of the subjunctive. Learn to be able to read fairly decently without much reference to a vocabulary. Go down to Leary's and pick up a few of those simple German, French, or Spanish stories and read them. They will come easy to you. Then try some simple scientific readers and finally, subscribe to a foreign language magazine. Try it fellows. It's much more effective than Dr. Coué's method of making yourself better day by day.

The New Coach

WHEN some one asks you for your opinion of that elusive, mysterious, indefinite "football situation," what do you do? Do you shrug your shoulders, and look non-committal, and then finally give a confidential but stubborn view of the whole thing, as a great many of us do? It's a big subject, this football question, and many, diverse, and full of genuine spirit are the sage and knowing discussions of it, all over the campus. But in general, the trend of thought is directed in the same channel —we give all due credit to the régime that has gone before, and wait for time to tell what the new one can do.

The selection of "Lou" Young as mentor of the Red and Blue team is an epoch-making one, inasmuch as Head Coach Young is the first man to fill that position who has not had a previous great amount of experience. It is of particular importance and interest to ourselves because "Lou" Young is a graduate of our own Towne Scientific School, receiving his degree as B.S. in Civil Engineering in 1914. We are all familiar with his record as a player on the varsity eleven, and we know that he has always held the interest of his Alma Mater at heart.

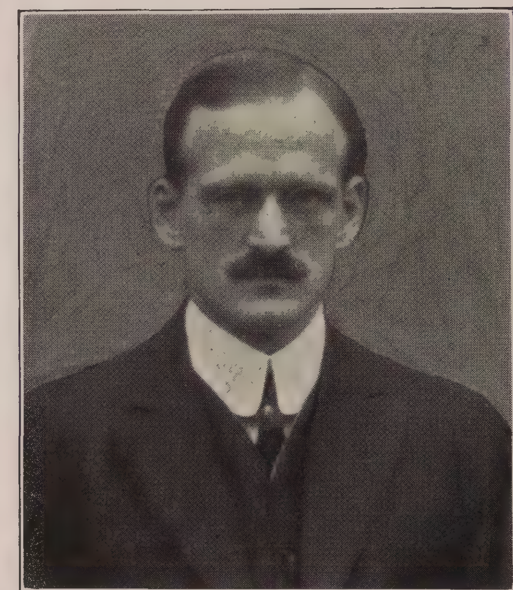
As to Coach Young's qualifications and ability to fill his responsible position, we are not in the least skeptical, but on the contrary, we believe whole-heartedly that he will meet with success. Being an engineer, he will face his problems and tasks *as* an engineer.

So let's all get behind him from the start, fellows, and do our utmost to help him. It's all for dear old Penn.

Important Research in Germanium and its Compounds

CARL R. DOLMETSCH, CH. '25

IN THE swift whirl of the course of current events at our great University, we are more than apt to neglect looking about us. We are inclined to forget that in our immediate midst—under our very eyes, as it were—some of the greatest and most remarkable achievements in the scientific world have been made, and indeed, are still being made. This implies especially the research work carried out under the direction of the Department of Chemistry. We undergraduates, as a whole, are at best familiar with the fact that the use of tungsten as a filament material in electric lamps was made possible by Edgar Fahs Smith, former Provost of the University, and Professor Emeritus of Chemistry. Some of us may be fortunate enough to be aware that some of the greatest work in exhaustive investigation of tungsten and its compounds has been but recently completed in our own Harrison Laboratory. Research work in the study of other of the rarer elements has led to the discovery of what promises to be one of the greatest boons given to civilization in this century—the discovery of the effect of germanium dioxide on the blood. This was achieved through the tireless efforts of JOHN HUGHES MULLER, M.A., Ph.D., and his co-workers. It is to this and the relative work with regard to germanium that we will turn our attention.



It does not necessarily require a knowledge of chemistry to know that in 1869, a great Russian chemist, Mendeleeff by name, after investigation of the apparent simple relation existing between the atomic weights of kindred elements, reached conclusions which are comprehended by the term "Periodic System." Mendeleeff gave to the science of chemistry the first really practical periodic table, which, although somewhat modified, is still used and regarded as an invaluable organ in the study of the science. In this table, the elements, which are about eighty-three in number, are arranged horizontally in the order of their increasing atomic weights. After every eighth element (this excludes the chemically inert gases He, Ar. Ne, Kr, Xe, Nt,) a new line is begun, and the first eight labelled a "period." Naturally, the next set of eight elements, or period, will appear in a corresponding position below the elements in the first period, and thus places the kindred elements in vertical rows, one element below the other. Now, it happens that in some cases, the elements do not fall into the expected position, and to compensate for this requires an irregularity. They are by compromise placed in the vertical row of elements with similar properties, called "groups," and to account for the vacancies left by this compromise, Mendeleeff propounded the theory that there were still some elements which were as yet undiscovered. He even went so far as to predict the discovery of certain elements, and actually described their properties and chemical behavior. Of particular interest to us, he called attention to the future discovery of an element in the IV Periodic Group which he called "ecka-silicon." It is the more remarkable that in 1886, some thirty years later, Winckler, the noted German chemist, succeeded in isolating from a silver-bearing mineral, argyrodite, a new element, whose properties corresponded very closely with the prophetic "ecka-silicon" of Mendeleeff. Winckler, however, thought it was the missing element under antimony. He called it "Germanium," in honor of his native land. Thus it is then, that the "ecka-silicon" of the founder of the "periodic system" has borne that name ever since.

Peculiar it is, indeed, that no one paid much attention to the newly discovered metal, and until 1918, no possibility for any use for it ever occurred to scientists. It was then that Buchanan, a chemist in a zinc products plant, experienced difficulties in handling the zinc oxide ore. A white sulphide was continually precipitated in the course of his analyses, and its stubborn and extraordinary behavior with the customary zinc-compound reagents impelled him to pursue a study of the cause of his perplexity. He hesitated when he came to the nearest solution to his problem, which was the probability of a germanium compound in the mineral, but through further work on his part, the presence of germanium was confirmed. A portion of the ore was given to Dr. Müller, whose abilities as an analytic chemist are admittedly extraordinary, and this led to the great research work which is still under progress in some of its phases.

By a glance at the periodic table, it will be readily seen that germanium and arsenic are adjacent (atomic weights 72.5 and 74.96 respectively), and therefore, it is a perfectly logical assumption that their chemical behavior must be very similar. This in fact, was found to be true, and the separation of these two elements furnished the first real problem to Dr. Müller and his group of fellow-scientists. Several separations were on record, one or two of them being fairly good, but not accurate enough to give a sufficiently pure metallic germanium for the determination of the atomic weight. It was during the investigation of a better method of separation that Dr. Müller's attention was called to the possibility of a physiological action similar to that of arsenic and vanadium—but we will turn our attention in this direction later on. After an involved and lengthy study, Dr. Müller in December, 1921, through the medium of the *Journal of the American Chemical Society*, announced a separation of germanium and arsenic, together with some important conclusions with regard to these elements.

We cannot furnish details here relating to these experiments, but we can offer a flighty sketch of the results. It was found that hydrogen sulphide, which ordinarily precipitates germanium as the disulphide, GeS_2, in the presence of very concentrated hydrochloric acid, and under pressure, is entirely without action upon the germanium compound if the latter is in the medium of hydrofluoric acid. In other words, hydrogen sulphide is entirely without action upon solutions of fluogermanic acid, and the alkali salts of this acid. The arsenic comes down readily, and thus a very rapid, sharp and accurate separation is afforded; it is accurate enough o determine as little as 0.01 per cent. of arsenic in germanium compounds. This method of separation is especially useful in connection with the preparation of pure germanium compounds, as the fractional crystallization of the double fluoride can in this way be avoided. The precipitation of the arsenic, moreover, is complete and rapid even in the cold.

We have mentioned above that the extremely close association of arsenic and germanium led Dr. Müller to reason and wonder, "Is germanium dioxide toxic, like arsenic trioxide, or vanadium pentoxide? If it is, is it more so, or *less* so, as would be believed from the non-toxic character of the elements in its own periodic group (silicon, carbon, titanium, tin, lead)?" It is known that the derivatives of the oxide of arsenic, under the commercial name of "arsenic," is in common use, and has been for years, as a powerful tonic and alterative in blood and skin disorders (Fowler's Solution, the cocodylates, arsphenumi, etc.). It is also used in cases of anemia, chorea, and other nervous diseases. Experiments were then carried out at the Wistar Institute of Anatomy and Biology by Dr. Müller, and Dr. Frederick J. Hammet, the results of which showed the pleasing fact that germanium dioxide is many times *less* toxic than arsenic trioxide, and what is even more remarkable, that the former has a marked "erythopoietic action," like that of arsenic trioxide, when taken in small doses. The formidable term, "erythropoietic action" means essentially that it has the power of promoting the increase in the production of the red corpuscles of the blood—and it is to the red corpuscles that the blood owes its color and its power to carry oxygen.

The experiments were carried out with albino rats as subjects. It was found that the rats which received the germanium dioxide thrived and grew about twice the amount of those which did not. Then, experiments were carried out in which guinea-pigs were used as subjects, and similar results were obtained. In order to continue and verify further the results of the work thus far accomplished, the germanium dioxide was given successively to a guinea-pig, a rabbit, a dog, and finally, to a man, both subcutaneously, by means of a hypodermic needle, and internally, by taking it through the mouth. Perhaps most interesting to us are the results pertaining to the human being.

In determining the erythopoietic action of germanium dioxide in a man, the dose of the oxide was administered through the mouth, in an aqueous solution. The latter was taken on an empty stomach, in each instance, on the half hour before a meal. Before the initial dose was given, the weight and red blood-cell count were taken. Observations of the blood count and body weight were continued for a period of over six weeks, and the results obtained corroborated

in every way those from the laboratory animals. The investigators found that they could demonstrate a rise in the red corpuscle count of at least one million above the count obtained just preceding the first dose, and an increase in the haemaglobin of 8 to 10 per cent. above the normal reading!

In logical sequence of these discoveries, the question of the actual toxicity of germanium dioxide was taken up. Experiments of an intensive and exceedingly delicate nature were conducted once more upon rat, guinea pig, rabbit, and dog. The percentage per kilo weight of germanium necessary for a lethal dose was calculated from the results of these, and check tests made. From these it was learned that the actual fatal dose is 586 milligrams of germanium dioxide per kilo body weight. These results appeared first in the *Journal of the Medical Sciences*.

Following these investigations, Dr. Müller and Miriam Stewart Iszard, M.A., continued the research and concerned themselves with a study of the cumulative effect and elimination of the germanium dioxide. By "cumulative effect" is meant that the internal organs of the animal body accumulate and restrain from elimination, the oxide. Arsenic trioxide furnishes the best example of this. Gratifying it was, to be sure, to find that with germanium dioxide there is *no cumulative effect*, as was shown by an analysis of all the internal organs of the animal body—the lung, liver, kidney, and in addition, the bone marrow and muscle.

It would then, of course, be reasonable to ask what would occur if an overdose—one which was, nevertheless, within the limits of the fatal dose—was administered, and how it was eliminated. Experiments were carried out on a rabbit, a dose of over 230 milligrams being first given. A careful study was then made of the material eliminated for thirteen days. Chemical analysis was made of the samples of the urine and fecal material, with the following results. First, the overdose of germanium dioxide was rapidly eliminated from the system, amounting to about 60 per cent. of the total dose received. This occurred within twenty-four hours following the dose, and analysis showed it to be practically entirely eliminated through the kidneys. In the second place, after the expulsion of the overdose, the elimination became fairly constant over a long period, and the amount eliminated from the intestinal tract increased slightly. When a man was used for a subject, corresponding results were obtained. The details and conclusions of this work appeared first in the *American Journal of the Medical Sciences*, together with a method of the separation of the germanium dioxide from the organic matter, in the presence of or the absence of arsenic.

It is due to this great amount of valuable research and discovery that the medical world feels that a great boon has been given to civilization. The possibility of an adequate production of the still rare, but now available, germanium dioxide, and its application in medicine as a tonic, has caused physicians to look forward eagerly to the time when the use of arsenic trioxide can be abolished—at least in part. No actual attempt has been made by Dr. Müller and other scientists to replace the long used arsenic oxide by germanium dioxide in medicine, because they believe that there is still a great deal to be learned about this wonderful substance. But medical men have acclaimed it, and it is unquestionably destined to be one of the most beneficial discoveries of the age, for curing anemia and nervous diseases, and as a general stimulative tonic.

To culminate the already great amount of research work regarding germanium and its compounds, Dr. Müller, working with the co-operation of Nicol H. Smith, next turned his attention to a study of the compound known as germanium hydride. They worked with special attention to the curious fact that both germanium and arsenic respond to the well-known Marsh test, so commonly used in the toxicological recognition of arsenic. Voegelin had made germanium hydride as early as 1902, but he was unable to thoroughly investigate this compound owing to the extreme scarcity of germanium at that time. The best results of Voegelin only indicate that the formula probably corresponds to GeH_2, as determined by the action of the hydride upon the solution of a silver salt, and several analyses of the diluted gas by passage over finely divided sulphur, whereby the germanium hydride was converted to the sulphide. Second, the spots formed by allowing the burning hydride to impinge upon porcelain surfaces were described as somewhat similar to arsenic spots, and the solubility of the metallic germanium in those solvents commonly used for the confirmation of arsenic was recognized. This is all carried out in what is known as the Marsh Apparatus, familiar to even the student of elementary chemistry. Its effect is essentially that nascent hydrogen, liberated by the action of zinc upon an acid, reduces a suspected compound of arsenic, antimony, or germanium, and forms the corresponding hydride. By heating the latter, which is volatile, in a confined tube, a film of the free metal is obtained as a so-called "mirror." The hydrides are also tested by the color of their respective flames, and by allowing the gas to pass through a solution of a silver salt, thus forming a and precipitate of metallic silver in the case of arsenic, tetrasilver germanide, Ag_4Ge, in the case of germanium, etc.

It required a great deal of time and energy on the part of Dr. Müller and Smith in experimenting with the hydride. Preliminary details, such as the procuring of acids free from traces of arsenic, antimony, and germanium, the selection of the most suitable type of generator, furnished the first obstacles, but these were soon overcome. Involved, lengthy, and painstakingly accurate experiments were conducted, and it was found that germanium may be detected by a modification of the Marsh Test in quantities as small as 0.0006 gram of the metal; (2) the delicacy of the hydride reaction is greatly increased by the use of the alkaline type of generator as a source of nascent hydrogen, aluminium and dilute potassium hydroxide solution serve best for the formation of a large amount of germanium hydride, and sodium amalgam for small quantities; (3) the decomposition temperature, or the temperature at which the hydride breaks up to give the mirror mentioned above, lies between 340 and 360 degrees Centigrade, and the deposition of the mirror is best obtained below a red heat; (4) they determined the dissimilarity of the films of germanium and arsenic as obtained by the Marsh Test, by spectroscopic analysis; (5) they found that the silver germanide is apt to be of variable composition, and may consist of nearly all silver, with very little combined germanium, or very nearly pure tetrasilver germanide, depending upon the method used in the preparation of the hydride, and further, they found the conditions which favor the formation of the tetrasilver germanide, and also those which result in the formation of free silver, and soluble germanic acid by the action of the hydride upon a silver salt.

Dr. Müller is tireless in his efforts and in his study and investigations of germanium and its compounds. He stands today as perhaps the leading authority on this subject, as well as on other of the rarer elements, and is justly acclaimed as the donor of a great gift to mankind—the use of germanium dioxide in lieu of the more toxic and dangerous arsenic. He has not finished the task which he has assigned to himself, but continues to carry on, determined, it seems, to push the study of the subject to the limits. His interest never abates; it seems as if he becomes more eager in his search for new facts about germanium every day. We, as a student body, are proud to have this great scientist in our midst, not only because he represents a great height in the science of chemistry, but also because the University of Pennsylvania is his Alma Mater, as well as ours. But let us learn to look more closely into these matters which are so vital a part of our University life, and which are so often lost to us by our neglectful attention. We have much to be proud of, and it is for us to examine the events around us in order that we may appreciate these things which are ours. We can get an idea, perhaps, from what has gone before, of the greatness and importance of Dr. Müller's work, but there are others. Let us look for them.

Phosphorescence

R. Borgersen, M.E. '26

PHOSPHORESCENCE has always been the most mystifying of all the phenomena of nature. It is not strange, therefore, that many years, even centuries, elapsed before men finally fathomed out the secret of this light in which there is not the slightest evidence of heat. Years ago searchers, probing into this strange phenomena, revealed that phosphorescence has its source in a substance known as luciferin. Because of the extreme difficulty in separating a sufficient amount for experimental purposes no important revelations were made. It remained, however, for E. Newton Harvey, a Princeton professor, to discover a means whereby the luciferin, obtained from a multitude of tiny sea creatures, could be collected in sufficient bulk to produce a light of unusual brilliance. The discovery, simple enough though it seems, involves a method for drying these tiny creatures immediately upon their being procured, and of converting them into a fine, yellow powder by means of grinding. This must be done as rapidly as possible, for once removed from the water the luciferin readily unites with the oxygen of the air, and is thereby rendered useless. Luciferin itself is not capable of producing phosphorescence, but only with a second substance, luciferase, with which it combines, is luminescence brought about, and then only when oxygen is present.

Contrary to most instances of combustion, little or no heat is evolved upon the union of luciferin with oxygen. It is estimated that the amount of energy released in the form of light is 99 per cent., leaving only 1 per cent. of heat energy. In striking contrast to this is the ordinary incandescent lamp, in which 96 per cent. of the total energy released is in the form of heat, and wasted heat at that.

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Selenium Cells for the Experimenter

Leroy Vanderford, M. E. '24

ONE of the many things that is now interesting scientists and inventors is "Television", the science of seeing over wires. The element Selenium will no doubt help to solve this problem.

Selenium is one of the most peculiar and interesting of all the chemical elements. It was discovered by Berzelius, a famous Swedish chemist, about 1817, and belongs to the same group as sulphur. It exists as a brown amorphous mass and in a gray metallic crystalline structure. The thing that makes it such a favorite with the experimenter is its property of being a fairly good conductor of electricity when exposed to light but almost an insulator in darkness.

However this peculiar effect is only noticeable when it is in the crystalline state. For demonstrating this action of light, Selenium cells are commonly made by embedding two electrical conductors in a very thin coating of Selenium. This cell is then annealed in a warm oven till it changes into the crystalline form. The process of annealing is the most difficult and most important stage in the construction of Selenium Cells.

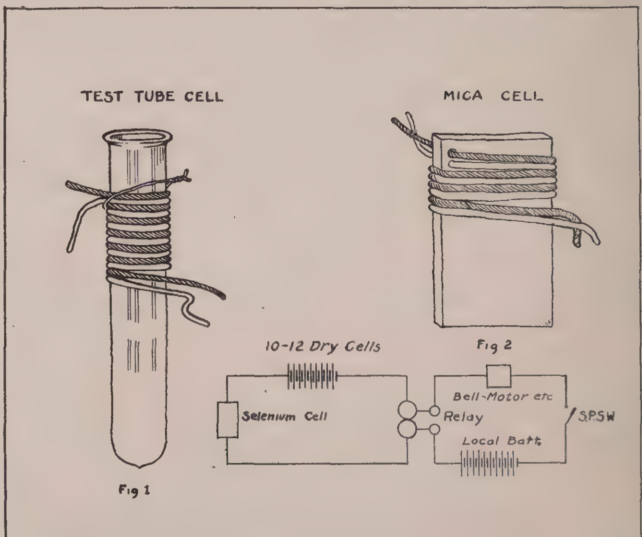
Although it takes persistency and skill to construct a real good cell, one is amply repaid for the effort and time spent in making one. If the experimenter is fortunate enough not to have any recitations or gym classes tomorrow he might care to try his luck, and make a few from the following "destruction details." The types of Selenium Cells shown in the figures were made as follows:

The Test Tube Selenium Cell

This cell is made by winding two pieces of No. 30 enameled copper wire parallel to one another around a glass test tube (small size, about 3 in. long). The two wires are best started in winding by temporarily tying them with a piece of thread. The tube is then wound to within a half inch of each end with the two parallel conductors. The wires should be wound smoothly and evenly, then bound at each end with a piece of fine wire so that the winding will not slip loose. Now ask "John" for a piece of fine sandpaper and scrape the enamel from the outside surface of the windings. This will leave two electrical conductors wound side by side with nothing but a thin coating of enamel separating them. From this point give paragraph 3 the well known O. O.

The Mica Sheet Cell

Cut a piece ½ by 2 ins. from a sheet of stiff mica. For three-quarters of the length of this small sheet wind two No. 30 copper enameled wires parallel to each other, as in the test tube cell. The ends of these wires may be fastened by pushing them through small holes drilled in the ends of the mica sheet. Again the outside surface is scraped off with fine sandpaper. Now it should look like the "See me Fry" number two. It is well to test the windings with a dry battery and a telephone receiver (if you live in an apartment house you will have little trouble finding one that will serve the purpose in the first floor vestibule) to see that the wires are not short-circuited. If a click is heard in the receiver express your feelings in some dead language or "Students' French 2" and start over again. If no click is heard in the receiver everything is all right to proceed.



¶3. It is now necessary to have a strong constitution and a bunsen burner oven. The unfinished cell is placed on a small piece of tin and held over the bunsen burner till it is hot enough to melt the Selenium. A small stick of Selenium is now rubbed over the wires, leaving a thin coat of Selenium covering them. If the cell is too hot the Selenium will collect in drops, and not spread evenly while if it is too cool, the cell will not be coated thin enough. The coating should be as thin as possible yet be continuous. With the cell coated on all sides it may be removed and allowed to cool. It should now have a smooth glassy surface.

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"The Engineer and the Architect"

By Dr. Warren P. Laird

Dean of the School of Fine Arts, University of Penn·ylvania

POSSIBLY in the past forty years, the engineering profession has undergone a greater development than in any previous period of its existence. We who are not engineers look upon the development of that profession as a very remarkable thing. It has kept pace with, and is largely accountable for, the great growth of industrial activities. That would have been impossible save for the engineers. And along with the industrial activity of the country, wealth producing activity generally has grown, and has grown immensely, needing the great constructions which the engineers have created and developed.

I am not able to give a definition of the engineer. Nor, perhaps, should I attempt to, of the architect. A profession which is so complex and makes so many demands upon training and intelligence and experience and judgment as do those of engineering and of architecture, is a profession that is very hard to compress into a definition.

However, I would like to say a word to you of the architect's point of view; of what the architect at his best tries to stand. I want to do that because I believe between the architect at his best and the engineer at his best there is the possibility of a full reciprocal relation. I believe that the one does not at all render the other unnecessary, but where each is performing his function in the best way possible, they are both necessary in the life of this country and its advance in civilization.

The architect is a man who produces buildings, and these are works of utility, almost invariably. He would not exist if he had to do only those very few works which are small and monumental and mere expressions of sentiment. The architect almost invariably has to deal with a work of utility, as does the engineer. The architect, however, is expected to bring to that work of utility an element with which the engineer does not charge his mind and for which the world generally does not hold him responsible. That we may define as the element of beauty.

The implication is that, if the architect is concerned with beauty he cannot well be a very practical person; and that the work of utility must look to some other talent than his if it is to become useful and enduring. The impression frequently obtains that the architect is a dreamer of dreams, a maker of pictures, a conserver of beauty, and a general nuisance to the practical man. The conception is wrong. I do not state it before you in an accusing way. It is not your view, but it is a view sometimes held of the architect where he is not thought of very carefully.

In the schools we teach our students fundamentals; and it is one of the major fundamentals that architecture, to be successful, observes three great laws. It observes, first of all, stability—the building must be well built to be good architecture. It must be economically built. There must be conservation of material, of cost, or it is not good architecture.

In the second place, it must be convenient—must adapt itself to its purpose, and perhaps the central thought of the architect, in his preliminary studies, is to produce a good plan, a good arrangement of parts.

And the third element, which goes without saying, as Hamlet does in the play, is that of beauty.

We try to bring to the consciousness of the student that conception of architecture. If he has it, if he is trained under it, if he remains true to it, he becomes a good constructor, he becomes a good planner, and he is able to give to his buildings the semblance of beauty, to give to them good proportion and color; good lines, good detail, and a true expression of their purpose; in short, a spiritual quality.

That program for architecture means that the architect must be a pretty broad man; that he must have a good mind; that he must be educated in the laws of construction; that he must have a good training in the theory and practice of composition, or design; that he must have his taste and his creative instinct developed under discipline. All this we try to do, and it is attempted in all the good architectural schools of the country. It is the endeavor to train him in those three laws and to bring him finally to a state where he will be able to master the problems of architectural practice.

Another thing that we teach him is that he is not the master of everything with which he comes in contact. He cannot expect of himself, and the world does not expect of him, to be able to handle complicated or unusual problems that lie in the field of the engineer, and therefore he must have in service upon the building that he is designing that expert knowledge which can be found only among the engineers in the field

of steel construction, of sanitation, of illumination, and so on.

But why is it not possible for those two intelligences to function together? I believe it is. It only needs for each to come to a better understanding of the other.

The engineer, I think you will let me say, dismisses from his mind, as being outside of his field, any concern for beauty. When he has designed a bridge or any other work, he has put into that design all the material that the use of the structure will require and not an ounce more because that, being superfluous, is waste. He has covered every factor of safety but he will not waste any material and he will perhaps regard that thing which produces the element of beauty as being excess of necessary material. That, however, is not quite the way to look at it.

The architect does not produce his effects through wastefulness, through excess, through prodigality or improvidence, but he is aiming to produce something that will satisfy not alone scientific judgment, that will not simply bear strains and endure the asperities of time and weather, but he is trying to satisfy something that lies beyond that scientific judgment and that exists in the mind and heart of man—a love of the beautiful. He is trying to give something to the observer which will satisfy the intelligence in the first place and which will go beyond that and satisfy the craving for beauty.

Among the few things that we architects believe and teach is this proposition, that beauty is not to be had at mere money cost; that it is not always, and perhaps not often, necessary to go beyond the economic requirements of a building to make it beautiful. On the contrary making a building beautiful is a question of good taste and good judgment in the employment of material; shown in the selection of materials that will harmonize in color; that have good texture and will please the eye by their surface character and by the selection of ornament that will be appropriate and well placed.

Under the severities of his training, the architect comes to learn that the process of making a thing beautiful is the process of simplifying it. I wish I could show you the process through which the student passes, in which we harrow his soul by requiring him to leave things out, whereas his instinct is to put things in to make his building beautiful. Ordinarily the simplest things are the most beautiful.

Sometimes there is a deliberate effort to make a thing sumptuous and rich and gay, but that is an essay in a certain kind of design. The result may not be satisfactory because it is a great deal more difficult to make a very extravagant thing beautiful than to give that quality to a simple thing.

The architect's great concern, then, in his work is design, or composition; that is to say, the arrangement of the parts into a whole. In designing his plan, he has in mind not merely the distribution of spaces into a convenient arrangement, or the nature of the structure which is to support the roofs and to separate those spaces, but also of something that he must carry along at the same time; he has in mind always the producing of something which will develop into a form of beauty. It is one of the commonplaces in architecture, in the judgment of designs in architectural competitions—I think that is not commonly realized—that the jury will attach greater weight to plan than to elevation; and if there is a slight difference in merit between two plans, it would take an extraordinary badness in the elevation of the better of those designs, and an extraordinary beauty in the elevation of the second best design to give that second best plan the first place in the competition. The best architectural jury will look first at the plan, to see whether it is going to produce the utility that will meet the purpose and whether it is going to be economical in its construction or not. They feel a security in doing that because of the fact that a good plan will produce a good elevation in competent hands. Hence, the architect's major responsibility and the thing that occupies most of his time and study is the problem of providing something practical, something that will satisfy economic requirements, and he can best produce a work of beauty out of those conditions.

Recently the Engineers' Club has been very active in helping forward the development of the Sesqui-Centennial. It has done splendid work, and not the least gratifying part of its attitude is the co-operation of its representatives with the Philadelphia Chapter of the American Institute of Architects. It has been found, I will venture to say—although I am not in intimate touch with the details of the work—it has been found that that work can be done smoothly and happily by the two groups acting in co-operation. I have heard nothing to the contrary and some testimony to the effect that that is true. May I tell you why I think t is largely true? Because among the architects with whom you have been working—and chiefly in the person of Paul Cret—there is the binding force of that principle that I have just been speaking about—a consideration, first of all, of the practical. I know Paul Cret very well; have known him for many years. I have worked with him upon professional commissions and observed the workings of his mind, both in such work and in his teaching of his students, and he is

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The South Street Bridge

LOUIS M. STEINBERG, C.E. '24

UPON a "Penn" State man—a Civil Engineering student—rests the credit or blame, if you will have it, for the appearance of this article. It was during the Christmas holiday that my friend commenting upon Penn's engineering courses claimed that its one and only advantage over that of State's was that it afforded the students an opportunity to come into direct contact with engineers and engineering operations, because of its situation in the heart of a great manufacturing city. This is not intended to be a treatise on the comparison of the different schools so I'll not relate here what I told him. However, that one remark of his, true insofar as it was one of the advantages, lodged itself in my brain as a bit of irony. Just a few weeks before this utterance a few Penn Civil Engineering students, of which I was one, had made an inspection tour of a cement mill near Allentown, Pa. This trip used up one whole Saturday of which about only two and one-half hours were spent on actual inspection. We all agreed that it was a day well spent. It is understood, of course, that had not our Professor volunteered to lead us we never would have gone. Yet here was a bridge being erected under our very noses, practically on the campus, and I never could find time to waste a few minutes to give it the once over. Funny old world, isn't it? Well, anyhow I did finally set my eyes on it. I also decided, and I'm sure it is true, that not very many other students of our University had ever set eyes upon it since the old one was torn down. Hence this article.

The old South Street Bridge was erected in 1875 and in its day was considered a very creditable bridge. It was a swing-draw cantilever swinging horizontally on a central pivot. But Father Time had his say and so after an interval of about fifty years, after much strengthening and repairing it was pronounced unsafe. So the year 1922 brought with it the end of the old bridge, and the beginning of the new

The city of Philadelphia awarded the contract to the Dravo Engineering Company of Pittsburgh. The Dravo Company in turn sub-letted the steel work to the American Bridge Company.

The new bridge is to be of cantilever construction with trunnion lifts over the main channel. The old masonry abutments used for the original bridge are also to be used for the new bridge. These are 582.0 ft. face to face. Four new concrete piers are to be built. Of these four, two are the main piers which will carry the lifts. For the benefit of those who may not know the lift is that part of the bridge which rises vertically in order to allow for the passage of large ships. There are two lifts, one on each of the main piers, which carry trunnions—large pins—upon which the lifts pivot. When in their normal position the lifts join at the center of the bridge thus allowing for the passage over the bridge. These lifts are operated by means of four 35 H.P. electric motors which are controlled from the east main pier. Each lift is supported by a counterweight weighing in the neighborhood of 400 tons.

Borings were taken to determine the depth to which the piers would have to be sunk and it was found that the rock under the river dips toward the west. Consequently the deepest pier is the most westerly one which is 52 ft. below mean high water. The two main piers are each about 43 ft. below mean high water. Compressed air caissons were used in sinking the piers. As a matter of interest it might here be stated that compressed air caissons of the same kind as here used—though, of course, larger—were also used on the Delaware River Bridge now under construction. The piers are faced with granolithic concrete and bush-hammered to give them a pleasing appearance. Each of the two main piers contains an ornate operating house to shelter the men who operate the bridge.

The main piers have a cross-section of 107 x 23 ft., 6 in. They are 130 ft., 3 in. center to center thus allowing a maximum distance between fenders of 100 ft. The fenders are heavy wooden planks bolted on to the channel sides of the pier to protect them from being unduly weakened from battering and wear. The center line distance from the main pier to the intermediate pier is 128 ft., 6 in. allowing a channel clear of 101 ft., 6 in. The distance between center line of this intermediate pier and the channel face of the abutment is 97 ft., 4½ in., the channel clear being about the same as that between the main and intermediate piers.

At the center between the main piers—that is, where the lift spans meet—the clear when in normal position is 36.62 ft. above mean high water. The approaches to the main pier have ascending grades of 0.25 per cent. They are joined by means of a vertical curve on the lift span. The main channel, that is

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Getting A Job When You Graduate

MR. SENIOR, have you got your life's job yet? If not, are you directing your energies toward that end according to any system, or are you merely being directed by your intuition and your sense of Propriety? You would not consider passing a final examination by your intuition and why go after the greatest thing in life, your life's job, in a less systematic way than you go after a mere final exam? There are a very few principles which may guide you in your search for a job and you cannot afford to be without them. A mere cognizance of them will place you head and shoulders above the man who is seeking his job blindly.

When you start hunting for a position you will probably feel like a marble sliding around and around on a polished surface unable to stop or to control your destiny in the slightest degree. This is a natural feeling so it won't help any to worry about it. The way to get over this feeling is to appreciate that getting a job is a sales problem and start work as a salesman to sell your own services.

The most important thing in the world to you is "you" and the most important thing to your employer is "himself." The man who hires you will do so because of what he thinks you can do for him. To get a job you must find out exactly what your prospect must think before he will hire you and then lead him to think those thoughts. This getting over on to the prospects' side of the fence is called getting the "you" attitude.

Do not waste any time and money hunting for the ideal job or some kind employer who is going to push you ahead in business. The thing to hunt for is an opportunity to render a service. All any good man needs is one foot inside of the door—just one opportunity to demonstrate his value to an employer. Money comes as a reward for service rendered. Looking at a job in this light means to an employer that you have the right mental attitude.

If you will remember this and act upon it, you will avoid one of the greatest misfortunes which can happen to any man starting in business—having his heart broken by an unscrupulous employer. Some companies have a policy of trying to get their work done by young men for very little money. These companies go to the college men upon graduation with beautiful word pictures of the things which come to their faithful employees. As the graduate sees the situation after the officer of one of these companies has talked to him, he has only to take the job offered to find his life work and be happy ever after.

The man who takes one of these jobs finds himself at the end of two or three years in an undesirable position. If he is single and has money in the bank he faces the necessity of quitting his job and starting all over again with some other company. If he is married and has been unable to save any money, he cannot gamble with a new job. His life is ruined. You probably know men in this position. The least said about them, the better. They are the fellows who never show up at their class reunions or Commencement. The way to avoid being one of them is to disregard whatever an employer tells you about your future with his company. No employer can guarantee your future and if he could there is no reason why he should.

In looking for a position you should proceed in a constantly widening circle. Approach first your nearest neighbor. Tell him exactly what you want so far as you know. Do not ask him if he knows of any such job but if he will help you find one. Get him to thinking about your problems, and working for you. Ask all your friends to help you. Get them at work on your problem. Then scour the following list of sources of prospects to find prospects for your services:

1. Co-operation of friends and business acquaintances.
2. Help-wanted advertisements in newspapers and trade journals.
3. News items, magazine articles and general advertisements.
4. Directories and mailing lists.
5. Schools, colleges, clubs and business associations.
6. New corporations, and companies being organized.
7. Situations-wanted advertisements in newspapers and trade papers.
8. Employment agencies.

If you find it hard to think of prospects among your friends and acquaintances, go over old scrap books, address books, correspondence files, family albums—everything you have. You will find many prospects in this way. Of the sources of prospects which I have given, three, outside of friends and acquaintances, are particularly worth while. These are "Help Wanted" advertisements in newspapers and trade papers; "Situations Wanted" advertisements in the same papers, and direct mail campaign.

If you were an officer in your class or a member of the football team or a good debater or an active fraternity man, this means that in some ways at least,

you are above the average man. In trying to get a position you should always use as a sales argument everything you did in college which tends to prove that you have ability as a leader of men. If you have managed an athletic team or a musical club or a dramatic club successfully this is always a good point to bring out.

If, in analyzing yourself, you find that you have not excelled in any way, use this fact as an argument. Generally speaking, business men are not looking for "boy wonders"; they won't want men to revolutionize their business. What they desire are men of average intelligence, with open alert minds, who have some appreciation of the importance of discipline and are willing to work and study hard to get ahead. The man who has not excelled in college should tell prospective employers that he possesses only average ability but that he can and will accept suggestions and will work hard to get ahead. In other words, turn every objection into an argument when you can possibly do so.

Probably more men secure positions by answering "Help Wanted" advertisements in newspapers or trade journals than in any other one way. It is important, therefore, that you know how to answer an advertisement. The first point to keep in mind in answering an advertisement is that you are *not* applying for something. A letter of application is a *sales letter*. You are trying to sell your own services. In your answer to an advertisement you should try to do only one thing—get an interview with the employer. To do this the employer must say to himself when he has read your letter, "This is the *kind* of man I want." You must lead him to think this thought.

You create this thought in his mind by doing five things: giving in your letter all the information asked for in the advertisement; making your letter clear, concise, correct and courteous; using strong first and last paragraphs; keeping the employer's interests in mind all the time you are writing to him; giving definite information (facts not generalities) about what you have done, can do and want to do. The first and last paragraphs of your letter are particularly important. Do not begin your letter with a statement to the effect that you have seen his advertisement and are convinced that you are exactly the man he needs. The employer knows this without your telling him. If this were not true you would not answer his advertisement. Don't "tune up in the presence of the audience." Start right in to tell him *why* you are the man he wants. If you find it hard to do this, write your letter as you naturally would write it—and then throw the first paragraph away. Always end the last sentence with a period. A simple statement such as "You can reach me by telephoning Main 4000" is a good ending. Don't try to force the employer into taking action.

In writing a letter you should never use any expressions which you would not use if you were talking to your prospect. This means that you must eliminate all such hackneyed expressions as "Beg to remain." Don't use the words "beg," "state," or any of those other expressions which are so common in business letters but mean so little. The stationery which you use is very important. The quality of paper and envelope should be as good as you can afford. Do not under any circumstances write a letter applying for a position on ladies' note paper. Use a sheet 8½ x 11 or gentlemen's note paper, which should measure not less than 6½ x 9 inches. The envelopes for this size are 4¾ x 6 ¾. In reading answers to advertisements nine employers out of ten will select and read first the letters which come in the best-looking envelopes. Unless an employer states in his advertisement that he desires all answers written with a pen, your letter should be typewritten. See that the type is clean and that the letter has a neat appearance.

If you are going to run a "Situation Wanted" advertisement to secure a position, you should place it in the paper or papers which are read by the people you wish to reach. In a large city, the papers which carry the largest amount of advertising are the best mediums. A fifteen or twenty line advertisement is much more likely to pull a good job than a small advertisement. Many employers follow "S tuation Wanted" advertisements in newspapers very closely. These men reason that the men who advertise for the positions they desire have more initiative than the men who try to secure positions simply by answering "Help Wanted" advertisements. "Situation Wanted" advertisements in the trade papers are very well worth while because these papers are read by intelligent, progressive employers. If the paper in which you are advertising permits display head lines in its classified columns you will do well to use one. If you start advertising for a position, don't expect results from your first advertisement. Run your advertisement three times during one week and check up the results. If you think it advisable, change your copy and run the new advertisements on the days when your medium has its largest circulation. Advertisements run on holidays, however, are probably not extensively read.

Under normal business conditions, a direct mail (circular letter) campaign to get the job you want is almost certain to produce satisfactory results. All

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TOWNE TOPICS

MEN ABOUT TOWNE CLUB

On January 11th the Club and all the participants in "Laying Letty Low" met at Bookbinder's for dinner. About fifty fellows attended, including a number of Alumni members of the club. The chicken and waffles were dispatched with gusto, and what was not eaten was thrown with good effect. Several speeches were attempted and one was nearly finished. An original limerick contest, with the diners racking their brains for choicest offerings, topped off the evening.

At a recent meeting of the Educative Committee twenty-seven men were elected to membership. They have all assisted in some way in producing the lastEngineers' Shows. Warning is given to these men that acceptance must be made on or before February 20th.

The Club, while its purpose is to put on the Engineers' Show, is considering enlarging the scope of its activities. Plans are already under way for the 1923 show.

LECTURE OF THE AMERICAN CHEMICAL SOCIETY

On Thursday, January 16th, Dr. Julius P. Steigletz talked to the Philadelphia Chapter of the American Chemical Society on some of the problems in the field of chemistry in medicine. The lecture, which was largely attended, was held in the auditorium of Harrison Laboratory, following a banquet of the Society at the Houston Club.

Dr. Steigletz is head of the Department of Chemistry in the University of Chicago and a former President of the American Chemical Society. His work during the war, as Chairman of a committee controlling medicinal drugs, has placed at his finger-tips information concerning the development of this problem in all parts of the world.

He traced the progress of the study of local anesthetics, hypnotics and specifics; the isolation and synthesis of the glandular excretions, and told briefly of the recent investigations of the equilibrium of the blood. In closing, he held out the hope that antitoxins might eventually be replaced by pure chemical specifics.

CIVIL ENGINEERING NOTES

Professor Berry, Acting Director of the Civil Engineering Department, has this year innovated an entirely new and very interesting idea. This is the deliverance of lectures and informal talks by eminent engineers who have secured their C.E. degrees from "Old Penn." These lectures are given every Friday morning at 11 o'clock and are illustrated by lantern slides. The rosters of the Seniors and Juniors are so arranged as to allow their attendance at these lectures without interference with classes. These talks are open to discussion during the deliverance and after, by the students and professors and all visitors present.

On December 8th, Mr. Granville Taylor of the McClintic-Marshall Co. gave an interesting and somewhat deeply technical talk on the construction of the Castleton Bridge across the Hudson River, New York.

On December 15th, Professor George E. Beggs of Princeton University, delivered a very good lecture on the method of determining stresses in indeterminate structures, like complicated arches, by means of the "paper model." Professor Beggs made clear his points by means of the blackboard, lantern slides and actual models.

On January 8th, the Civil Engineering Department heard another one of the Alumni, Mr. Albert Bertram Hager, Sr., Class of 1900. He spoke on the development of the Mill Basin Shipyard, Brooklyn, N. Y., and the actual construction of dry-docks therein. Mr. Hager is now Vice-President of the Atlantic, Gulf and Pacific Co., the largest hydraulic and dredging engineering company in the world. He is also Manager of the Mill Basin Shipyard.

December 12th brought a very interesting lecture by Mr. Hibbs, '88, on the development of the Philadelphia Fire Towers. Mr. Hibbs is the man who is really responsible for their development. He is at present the Chief of the Department of Building Inspection of Philadelphia.

SIGMA TAU

The Sigma Tau Honorary Society held their annual "Rushing" smoker Monday night, January 15th, for the purpose of meeting the members of the Junior Class who are eligible for election.

As a result the following were pledged:

C. C. Roth, C.E. '23
D. Wagner, C.E. '23
E. C. Shumway, M.E. '24
F. B. Sutherland, M.E. '24
H. B. McClure, Ch.E. '24
O. W. Manz, Jr., E.E. '23

A. I. E. E.

Since the joint meeting with the Civil Engineers at which the interesting talk was given on the Frankford "L" by Mr. Dodd, no transactions of great importance have taken place, although on Monday evening, January 8th, the Juniors and Seniors had dinner at the Engineers' Club. An interesting and very instructive talk was heard afterward.

At a student meeting of the society the date of which will be announced later, a talk will be given on, "How to Get Jobs and Why You Need Them."

WHITNEY ENGINEERING SOCIETY

Several very interesting lectures will be given next term, the dates of which have not been definitely determined as yet, but will be announced as soon as possible.

All students are urged to attend these meetings as they offer a great opportunity for the engineering student to meet and hear the messages of these men who have made good in their respective branches of the engineering game.

Negotiations are now under way toward the affiliation of this society with the A. S. M. E., but so far nothing really definite has been done.

TAU BETA PI

The following pledges are announced:

Edw. Theodore Grandlienard (Faculty associate member).
W. A. Larson
L. Bouillion
Wm. Reynolds, Jr.
R. Klauder
G. Becker
W. I. Brown
F. H. Praeger
R. E. Irwin
E. W. McMullan
G. H. Jaggard
L. R. Jeffrey
H. R. Paxon

The Union Electric Light and Power Co. of St. Louis is working on a new 25 million dollar generating plant which will help supply St. Louis with power. It has been estimated that at the present increase in use of electricity the Keokuk plant, furnishing 60,000 kw., and the Ashley Street plant, furnishing 1000 kw., will be exhausted by 1923. The new plant will have a capacity of 240,000 kw.

—*Transit.*

NEW PRESIDENT OF A. S. M. E.

The new President of the American Society of Mechanical Engineers, John Lyle Harrington, was born at Lawrence, Kansas, December, 1868. He graduated from the University of Kansas in 1895 with the degrees of A.B., B.S., and C.E. Later he received the degree of M.S. from McGill University, Montreal.

He has followed engineering work since graduation in the bridge and structural line, later becoming senior partner of the firm of Harrington, Howard and Ash, consulting engineers, Kansas City. In this work he has made a specialty of large movable structures of all kinds and has been responsible for many innovations of design and construction.

Mr. Harrington gave a short talk of timely interest before the local branch A. S. M. E. on October 21, 1922, at which time the national council of the A. S. M. E. met in Ithaca.

This is of special interest to Cornellians, since Mr. Harrington succeeds in office, Dean D. S. Kimball, Dean of the Engineering College. Cornellians have always maintained an active interest in the affairs of the A. S. M. E. A former Professor, John L. Sweet, one of the men who fashioned the engineering course in Sibley College, was a founder of the Society, and on the Executive council today we find there are six graduates of Sibley.

Dean Kimball thus passes into that honored group of "Past Presidents of the A. S. M. E." and all may rest assured that those qualities of character and leadership which have characterized these men will be borne out fully in the year to come.

The use of very heavy oils for fuels under all conditions of service has been made practicable due to recent developments of the department of the Navy along this line.

Preliminary heaters treat the oil as it comes from the storage tanks and deliver one-third of their output direct to the burners while the rest is returned to the storage tanks. This treatment, which permits the use of low grade fuels, makes oil burning more economical and practical under all climatic conditions. The battleship *Maryland* is being equipped with the new system.

Engineering News

Dr. Charles Russ Richards, former Dean of the College of Engineering at the University of Illinois, was recently inaugurated president of the University of Lehigh at Bethlehem, Pa.

Australia, in urgent need of more hard-surfaced roads, has recently dispatched D. V. Fleming, chief engineer of roads and bridges, to the United States for the purpose of studying American asphalt highways. He is particularly interested in the cost of laying various types of pavements, their durability, maintenance costs, drainage and grading. The development of truck and automobile traffic has made hard-surfaced roads an essential in Australia.

A new $600,000 steel bridge over the Missouri River at Booneville, Mo., is nearing completion, according to the November issue of the *Manufacturers' Record*. The United States Government appropriated $250,000 toward the bridge and the rest was raised by the citizens.

A student at the University of Pottsdam, Berlin, was found recently as a stowaway in the engine room of the United American liner *Bayern*. He was Walter Volz. He speaks a half dozen languages fluently and aspired to pursue his education further in American colleges. Volz told the ship's officers he believed stowing away in the engine room would give him first-hand information concerning the ship's mechanism, which would aid him in his study of mechanical engineering. He was put to work shovelling coal and deported upon arrival in New York.

A seven foot coal vein has been found on the Campus of the Rose Polytechnic Institute at Terre Haute, Indiana. It has been decided that students will work the mine. A number of those taking the mining engineering course have enrolled to sink the shaft. With coal at its present price we think this find at Rose Poly is as good as an endowment fund.

The transmission of power from Niagara Falls to New York by Wireless has been predicted as a possibility of the near future. The prediction came as a result of the success of a sixteen-hour test of electron tubes in the place of large alternators in transmitting wireless messages across the Atlantic Ocean. Scientists have, for some time, believed that wireless transmission of power might come to pass.

Pitman's Technical Primers (85 cents each):

The Testing of Transformers and Alternating Current Machines.

Electric Power Systems.

High Voltage Power Transformers.

Part of a fund of $400,000 to be set aside by the General Electric Company and to be known as the Charles A. Coffin Foundation, for rewarding and encouraging service in the electrical field, will be devoted to an annual prize of $5,000 to be awarded graduates of American colleges or technical schools with which to continue research work in this country or abroad.

Announcement of the prize and the terms of award has just been made by the General Electric Company as follows:

"Five thousand dollars ($5,000) is to be awarded annually for fellowships to graduates of American colleges and technical schools who, by the character of their work, and on the recommendation of the faculty of the institution where they have studied, could with advantage continue their research work either here or abroad; or some portion or all of the fund may be used to further the research work at any of the colleges or technical schools in the United States. The field in which these fellowships and funds for research work are to be awarded are:

Electricity
Physics
Physical Chemistry

"A committee appointed by the Foundation Committee will award such fellowships and funds for research work, with the advice and co-operation of a Committee of Three, one to be appointed by each of the following:

National Academy of Sciences.

American Institute of Electrical Engineers.

Society for the Promotion of Engineering Education.

"This Committee is to be known as the 'Charles A. Coffin Fellowship and Research Fund Committee' and the Fellowships are to be known as the 'Charles A. Coffin Fellowships.'

"The Committee to co-operate with the National Academy of Sciences, American Institute of Electrical Engineers and the Society for the Promotion of Engineering Education will consist of:

E. W. Rice, Jr., Honorary Chairman.

A. H. Jackson, Vice-President.

W. R. Whitney, Director of Research Laboratory."

Other prizes to be awarded under the terms of the Foundation are as follows: $11,000 in prizes for the most signal contributions by employees of the General Electric Company toward the increase of its efficiency or progress in the electrical art; a Gold Medal for the public utility operating company within the United States which, during the year, has made the greatest contribution towards increasing the advantages of the use of electric light and power. The company receiving the Medal will also receive $1,000 for its Employees Benefit or similar fund. There will also be a Gold Medal for the Electric Railway Company which has made similar contributions in its field.

The Foundation is being established in recognition of the services to the electrical industry of Mr. Charles A. Coffin, founder and creator of the General Electric Company, who recently retired from its active leadership at the age of 78.

The highest voltage testing transformer that has ever been sold is now being built by the Westinghouse Electric Company, to be installed in a new laboratory at the California Institute of Technology.

A potential of one million volts to ground will be produced, the transformer's capacity being 100 KVA or 1340 HP at this high voltage. It is to be built in four units, the whole weighing a little over a hundred tons.

It is interesting to note that a potential of a million volts between needle points will spark across an air gap of from twelve to fifteen feet.

Ultra violet light was, not so long ago, a laboratory curiosity, but it is fast becoming an important factor in numerous processes. A few of the more firmly established uses are outlined here. It will be noticed that, in most of these cases, the action seems to be catalytic.

The solarizing process in finishing patent leather now employs these rays instead of sunlight.

It is used in the hydrogenation of cooking and salad oils.

Artist's Oil is prepared by bleaching linseed oil with the rays.

Color materials are now tested by ultra violet light instead of sunlight, the period required being reduced from about two months to six to fifteen hours.

The light is used in the sterilization of water for swimming pools and like needs.

Tuberculosis and various skin diseases are treated by it.

Virtually all rubber aging and sunburning effects are now obtained by the use of these radiations.

The most common ultra violet lamps are made with a tungsten anode and a mercury vapor pressure of one atmosphere. The arc is concentrated in a narrow neck in the center of the tube, and it is at this point that the emanations are most efficiently produced.

Research in "Magneto-striction," or the effect of magnetization on iron, steel, nickel and other alloys, is being carried on by Dr. S. R. Williams at the California Institute of Technology. It was upon the observed phenomenon of change in magnetic properties of a steel with the change in hardness that tests were conducted during the war on steel for rifle barrels for the United States Army.

New books of interest to the Engineer and Executive are as follows:

TECHNICAL EXPOSITION by K. O. Thompson.

Note: Professor Thompson says "This is a textbook on the application of exposition to technical writing, designed for students in scientific, agricultural and engineering colleges." The book covers diction, sentence and paragraph structure, the business letter, journalistic exposition, advertising and technical reports.

UNIVERSITIES AND SCIENTIFIC LIFE IN THE UNITED STATES by Maurice Caullery.

Note: Dr. Caullery is professor of Zoology at Sorhonne. He has lectured as exchange professor at Harvard and has visited other American universities. A review of the book says "Nowhere does he better exhibit his grasp of the subject than in his discussion of the relation of the alumni to the endowed college." Quoting from the book: "Their loyalty is one of the undeniable marks of an idealistic side in the American mentality." A large part of the book is devoted to a discussion of scientific research, which the author considers to be the supreme aim of the University.

SALES SUGGESTIONS FOR PAPER BOX MANUFACTURERS by R F. Salade.

Note: Contains suggestions for promoting new business.

The Niagara Falls International Exposition

IT WILL soon be three hundred years since the discovery of the Niagara Falls by a white man. The first authentic account of this wonder of nature, preserved by documentary history, is found in the diary of Father Hennepin, who had heard of it from hunters and Indians and camped there on his memorable voyage through the great lake country. He wrote in 1678: "Betwix the lakes Ontario and Erie, there is a prodigious cadence of water which falls down after a surprising and astonishing manner, insomuch that the universe does not afford its parallel."

To fittingly commemorate the tricentennial of this discovery the business men of the surrounding states have planned a great international exposition—a world's fair to be held on the American side of the falls in 1926. The necessary funds, grounds and franchises have been secured; the general architectural features have been decided upon, and many of the various preliminaries have been completed. A pamphlet published by the Fair Company tells us that the fair will differ from other world fairs in that it will be a permanent one. It will be housed in buildings erected of steel, concrete, tile, glass and other incombustible materials and the use of cheap stucco finish upon pine lath, employed in building the temporary exposition halls of the Chicago and St. Louis fairs, will be avoided. It is thought that a permanent industrial exposition, housed in attractive buildings and properly managed, will permit a permanent display of machinery, textiles, decorative materials, commodities, etc., at very slight expense and will meet with the unqualified approval of manufacturers and business men generally.

The immense complex, covering a tract of about 5,000 acres of picturesque hill land, will form a city of palaces, built in the "Modern American Style" and totally unlike those of the world fairs of Chicago and St. Louis. The architecture used throughout will be typically American. The decorations will be structural rather than applied, but everywhere the visitor will find ornamental tile floors, carefully designed steel trusses, beautiful cut glass windows, handsome electric chandeliers, splashing fountains, etc., unified into structural labyrinths of immense dimensions.

The Niagara Fair campus will command an unlimited supply of fresh sparkling water, brought there from the falls by electric power and poured in swirling streams into the fountains, rock springs, rivulets and ponds that will ornament the extensive grounds. There will be a total of nearly 700 buildings, among them a stadium seating 80,000 visitors, large enough to permit automobile races and military drills to be held there; an auditorium and concert hall seating over 4,000; a hotel on the Canadian side, having 700 guest rooms with baths and a hotel on the American side, with 1,200 guest rooms with baths.

The Exposition will demonstrate the forces that are now waiting to be hitched up. It will not be a silent place like the expositions of the past. Machinery will be seen in operation producing the useful things of trade. Exhibits will be shown of every line of world industry.

It is evident to everyone that the region around Niagara Falls is bound to become the heart of the greatest industrial empire of all time. This is the main reason why the organizers of the fair have planned to make it a permanent institution.

While old Europe is quarreling and fighting, and while their statesmen are trying to gain power by means of big armies and crafty legislation, young America is working and inventing and producing. We believe in the busy and tireless dynamo—not in the big gun.

—*From an article in the "Kansas State Engineer" by Dr. J. D. Walters.*

"THE ENGINEER AND THE ARCHITECT"

(*Continued from page 14*)

the most talented teacher of design in this country. And in all his teaching and all his professional work there is evident the operation of a logical mind. The architectural profession thinks of Paul Cret as one of the most talented architects in this country. He has no superior in the ability to produce a masterpiece of architecture. But Paul Cret's mind is primarily a logical mind. He sees through the solution of a problem not along the lines of emotion, but along the lines of reason. A good deal more of that is needed by the architects. The most conspicuous failure among architects is perhaps among men who allow themselves to think only of one phase of their work, who consider themselves as architects without responsibility. There are men of that type in all professions. But the best architects are the men who do things in that way that

(*Continued on page 28*)

FITZGIBBONS BOILER CO., Inc.

PHILADELPHIA OFFICE
510 Real Estate Trust Bldg.

Established 1886

WORKS, OSWEGO, N. Y.

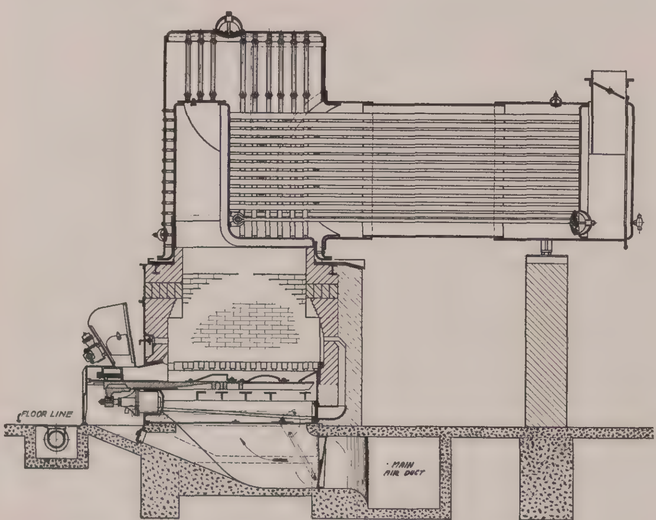
GENERAL OFFICE
NEW YORK
47 West 42nd St.

Manufacturers of the Fitzgibbons Boiler for Power and Heating

THE FITZGIBBONS BOILER:

Design: The Fitzgibbons Boiler is internally fired, retaining all the advantages of compactness and absence of brick-work peculiar to that type, while at the same time possessing certain features which are not embodied in the design of any other self-contained or brick-set type of boiler. It remains unique in combining with unusual compactness of design a very high combustion chamber and scientifically correct provision for supplementary air supply. Both of these features have been established by modern engineering practice as absolutely essential to complete combustion.

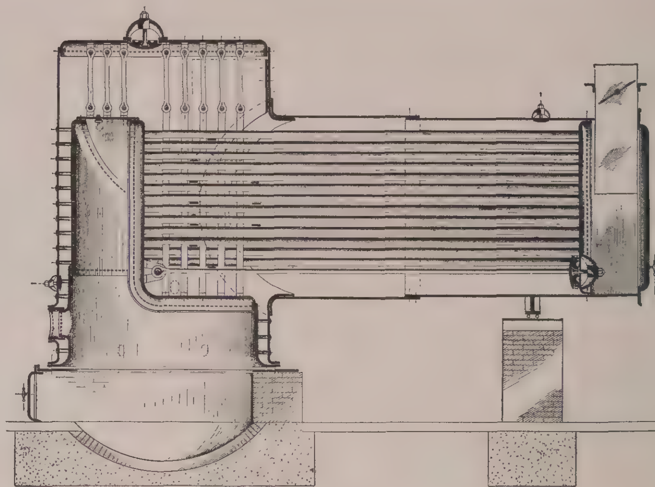
Construction: The A. S. M. E. Boiler Code governs every detail in the making of the Fitzgibbons Boiler. Built for working pressures of 150, 125 and 100 pounds for power and for 15 pounds for heating.



300-Horsepower High Pressure Fitzgibbons Boiler with Underfeed Stoker

Combustion: The distilled gases arising from the fuel bed are diverted by the lower crown sheet of the furnace directly across the path of the supplementary air admitted into the furnace above the fire door. A thoroughly intermingled mixture of air and combustible gases is created, which is completely consumed in the high combustion chamber at an extremely high temperature. Smokeless operation with semi-bituminous coal indicates the completeness of this combustion. The large number of tubes and the relatively low velocity of the consumed gases through them are so effective in heat absorption that the flue gases leave the Fitzgibbons Boiler at a lower temperature than in the case of return tubular boilers. The efficient circular grate and complete absence of brick setting eliminate the sources of air infiltration and consequent heat losses unavoidable in other types of boilers.

Circulation: The vertical and horizontal cylinders of the boiler present an unrestricted path to the water circulation, which is continuous with increasing rapidity from the rear of the boiler forward towards the vertical cylinder. By reason of this extremely rapid circulation and the high furnace temperature, the time required to generate steam is unusually short, making the boiler readily responsive to sudden demands for steam.

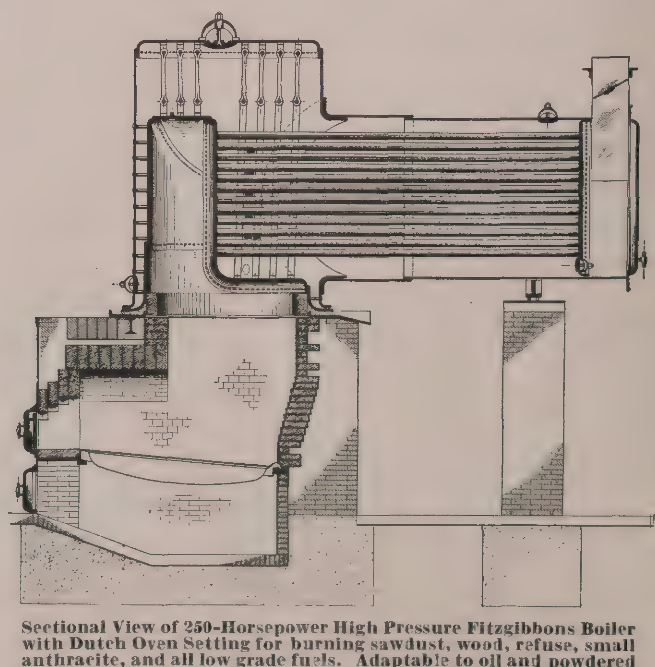


Sectional View of 225-Horsepower Fitzgibbons Boiler 125 Pounds Working Steam Pressure

Maintenance: Units up to 250 H. P. inclusive are regularly installed without firebrick setting avoiding recurring furnace repairs. All internal parts are readily accessible at all times for inspection and cleaning.

Typical Test Results

Rated boiler H. P.	150
Height of stack	116'
Draft at damper	0.497 in.
B. T. U. pound of coal	14636
Evap. per pound of coal	11.26
Efficiency	78.68%
Percent rated capacity	143.1%
Quality of steam	99.77%



Sectional View of 250-Horsepower High Pressure Fitzgibbons Boiler with Dutch Oven Setting for burning sawdust, wood, refuse, small anthracite, and all low grade fuels. Adaptable to oil and powdered coal burning equipment and waste heat furnaces

BRINGING MORE DAYLIGHT INTO INDUSTRIAL BUILDINGS.

Dr. George M. Price, writing on "The Importance of Light in Factories," in "The Modern Factory," states: "Light is an essential working condition in all industrial establishments, and is also of paramount influence in the preservation of the health of the workers. There is no condition within industrial establishments to which so little attention is given as proper lighting and illumination. Especially is this the case in many of the factories in the United States. A prominent investigator, who had extensive opportunities to make observations of industrial establishments in Europe as well as in America, states: "I have seen so many mills and other works miserably lighted, that bad light is the most conspicuous and general defect of American factory premises."

"My own investigations for the New York State Factory Commission support this view. In these investigations it was found that 36.7% of the laundries inspected, 49.2% of the candy factories, 48.4% of the printing places, 50% of the chemical establishments, were inadequately lighted. There was hardly a trade investigated without finding a large number of inadequately lighted establishments."

Inadequate and defective lighting of industrial buildings is not confined to the establishments in New York State alone. The same conditions prevail in most sections of the country.

Such conditions as mentioned above are entirely opposed to the laws of health, sanitation and efficiency. Wherever poor lighting conditions prevail, there must be a corresponding loss of efficiency and output both in quality and in quantity. American industry is not using nearly enough daylight and sunlight in its buildings. Every endeavor should be made to use as much as possible of daylight for lighting purposes. To obtain this it is of course necessary that the rays of daylight and sunlight are permitted to enter the interior of the buildings as freely as possible, with the important modification that the direct rays of the sun must be properly diffused to prevent glare and eyestrain. A glass especially made for this purpose is known as Factrolite, and is recommended for the windows of industrial plants. Windows should be kept clean if the maximum amount of daylight is to pass through the glass, but the effort will be well repaid by the benefits secured.

In the presence of poor lighting, we cannot expect men to work with the same enthusiasm as when a well lighted working place has been provided. The physical surroundings have a deep effect upon the sentiments of the employes, and where bad working conditions are allowed to prevail, there is invariably a lessening of morale and satisfaction created thereby. Neglecting to utilize what nature has so bounteously provided, daylight, and which is so essential toward industrial efficiency, we have an instance of wastefulness, but now that the importance of good lighting is becoming recognized, undoubtedly more attention will be given by progressive industrial employers to furnishing the means which are essential for their workers to secure and maintain the efficiency, which counts for so much in the success of any industrial concern in this competitive age.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

MISSISSIPPI WIRE GLASS CO.,
220 Fifth Avenue,
St. Louis. New York. Chicago.

SELENIUM CELLS FOR THE EXPERIMENTER

(*Continued from page 12*)

Annealing is the next process. Place the cell on a shelf in a small oven and turn the bunsen burner low. When the cell turns to a dull graphite-like appearance it is evidence of the crystallization taking place. This will probably take two cigarettes' worth of time. If crystallization does not start to take place within a few minutes increase the heat a trifle. Under no circumstance use enough heat to melt the Selenium. When the crystallization has completed (eight to ten minutes) the heat is increased till the Selenium begins to show signs of melting and fusion. At this stage the cell is instantly removed from the oven and in several seconds will recrystallize. The flame is now turned slightly lower than the point at which it showed signs of fusion and the cell is placed back in the oven and allowed to remain for two hours. Then commence cooling by gradually lowering the heat a little every ten minutes till the flame is extinguished. When the oven has cooled the Selenium cell may be removed.

These cells may have a resistance in the dark from 25,000 to 75,000 ohms; in the light enough current will pass between the two windings through the Selenium to operate a relay which can be wired to do most everything—even ring a bell alarm when the morning sunshine hits it thus saving many an 8 o'clock cut. A connection map may be seen in the illustration.

Selenium cells are used for receiving wireless telephone messages over a beam of light whose brilliancy is varied by means of a microphone placed in the circuit. Every sound is accurately reproduced at the receiving end by means of a Selenium cell in series with a receiver. Selenium cells are also used in Bell's "Photophone" and Korn's marvelous system of telegraphing photographs. It must be remembered that the Selenium cells will only operate telephone receivers and good polarized relays.

"THE ENGINEER AND THE ARCHITECT"

(*Continued from page 22*)

I have described as characteristic of Paul Cret. If that is the case, why can't we get together? I am sure we can.

The architect ought to be able—and he is an incomplete architect if he is not able—to solve all ordinary structural problems, but the exceptional problem frankly goes beyond him.

What is this factor that differentiates the architect from the engineer? It did not exist at one time. When those buildings were constructed that we regard as the world's masterpieces of architecture, they were constructed under a single intelligence—the great cathedrals, the monuments of the past, such as the Parthenon, of which Emerson, I think, said, "Earth proudly bears the Parthenon as the best gem upon her zone." We all admit that the Parthenon is man's masterpiece in architecture.

We separate our day from the day which produced those things. They were governed by a single intelligence which controlled construction, and design, and produced masterpieces. In these modern times and for some hundreds of years past, the architect and the engineer have been taking divergent paths; and today the engineer does a vast number of things which the architect could not pretend to do, and the architect does things that the engineer does not pretend to do.

Journal cf Engineers and Engineering.

PHOSPHORESCENCE

(*Continued from page 11*)

But what is the explanation of this absence of heat in phosphorescence? Why is it that the percentage of light energy in luciferin is so high, and so low in the ordinary incandescent lamp? The explanation is simple. The rays of light produced from luciferin are green and blue in color—both cold rays of white light. The red rays which produce the heat are evidently absent in phosphorescence, but present in large amounts in ordinary incandescence.

Many examples of phosphorescence are seen in nature. Numerous varieties of salt-water fish and marine worms as well as a large number of plants and insects are able to generate "cold light." A certain variety of fish called photobethron has a very unusual lighting apparatus. The light is produced within an inner chamber and burns continuously. Should the fish desire darkness, he causes a black pigmented curtain to fall like an eyelid over the light cell. It is a peculiar fact, but even after death the light organ preserves for a long time its luminescence.

Phosphorescence, you see, is not confined solely to maritime creatures but is also found in many insects and plants. Certain varieties of fungi, of which the toadstool is perhaps the leading type, give off a brilliant glow. The permanency of this luminosity varies greatly, in some cases lasting only a few hours, while in others this strange phenomenon continues indefinitely. Probably the most familiar and common example of phosphorescence is seen in the firefly so numerous in the meadowlands after dark. In this insect the light is projected through a cuticle which is transparent over the light organ the rest of the body being dark and pigmented. The oxygen necessary for the combustion of the light-producing substance is provided by the capillaries leading from the mouth of the firefly to the light chambers. Evidently the firefly inhales the air in spurts, which result in the penetrating flashes repeated intermittently.

Although science has discovered much concerning phosphorescence, it has not, however, as yet revealed the purpose of the luminescence. Many scientists, nevertheless, share the general impression that this bluish glow is primarily for protection. This theory is borne out by the fact that when the light organism is agitated in any way this bluish light begins to sparkle and then becomes intense and penetrating. Evidently the purpose of the light is to frighten off any possible antagonist. Thus, it is likely that phosphorescence is only another way by which nature protects certain forms of animal life which would otherwise become extinct.

THE SOUTH STREET BRIDGE

(*Continued from page 15*)

between the main piers, is 26 ft. deep below mean high water.

This bridge will contain, as before, two sets of trolley tracks set in a roadway 36 ft. wide. The distance between center to center of main side girders is 39 ft. To the outside of each of these girders there will be attached an 8 ft., 6 in. sidewalk. The elevation of the sidewalk is 38 ft. above mean high water. The overall width from edge of sidewalk to edge of sidewalk will therefore be 56 ft.

A typical section of the main girder consists essentially of a 7 ft., 00 x ½ in. web plate and four 8 x 8 x 1½ in. angles stiffened by 6 x 3½ x ½ in. transverse angles at intervals of about 5 ft. Each abutment and each of the two intermediate piers support two 4 in. pins 18 in. long upon which the steel work rests. The bridge will be paved with asphalt except on the lift spans where the paving will be wood blocks on account of their comparative light weight.

The steel for this job was fabricated in the Ambridge Plant which is in the Pittsburgh division of the American Bridge Company.

The estimated cost of the bridge is about $700,000. The bridge will, according to present indications, be completed the latter part of this summer.

GETTING A JOB WHEN YOU GRADUATE

(*Contininued from page 17*)

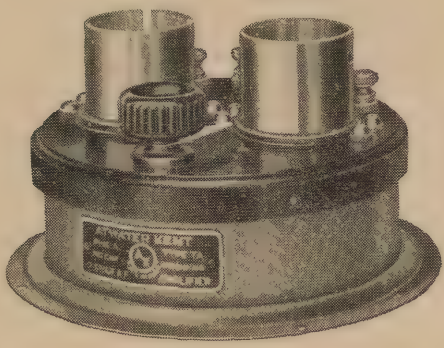
you have to do to get a job is to keep at it until you win. For the man who has a weak personality or who finds it hard to talk to strangers or has some other weakness, direct mail campaigns are worth very careful consideration. Through letters, you can *ant c pate* and *overcome* objections. If you cannot write a good letter, you can always get a trained advertising man to help you.

The principles which you should observe in running a direct mail campaign are the same as those you follow in answering an advertisement. One good way to run a campaign is to prepare a letter carefully and then send out ten copies. When your answers are received, you will probably be able to determine the value of your letter. If the first ten letters do not pull satisfactory results, have an advertising man check up your letter to see if it is a good one. Don't mail letters so that they will be received by prospects on Saturday or Monday. Letters received by business men on these days do not receive the consideration given to letters received in the middle of the week. The days just before and after holidays are also bad days to have your letter reach prospects. Telegrams and night letters can sometimes be used instead of letters. They always get attention.

—*W. L. Fletcher, in "Tech. Eng. News".*

ATWATER KENT

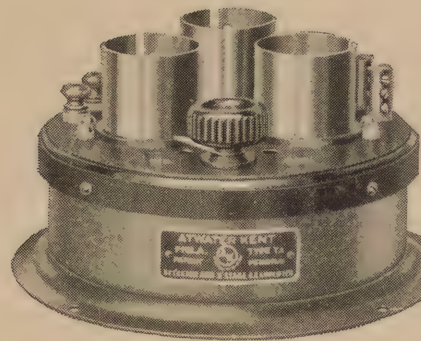
RADIO EQUIPMENT



2-Stage Amplifier—$14.00

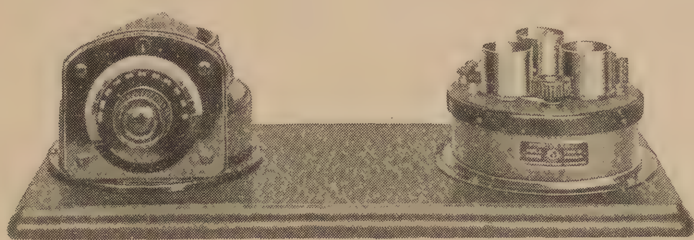
The 2-Stage Amplifier unit is not limited to any particular type of circuit, but is universally adaptable to any set-up requiring an audio-frequency amplifier. It is a compact, ruggedly constructed amplifying unit.

A similar unit is furnished in a Detector 1-Stage Amplifier at $13.00



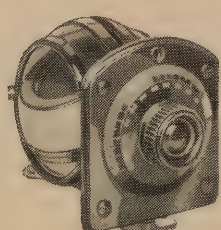
Detector 2-Stage Amplifier—$16.50

Maximum volume without sacrificing clearness of tone. Rigid construction and compactness. Hermetically sealed, absolutely no moisture troubles. The instrument was submerged in water 24 hours, taken out and placed in same circuit with results standard in every way.



The above set, consisting of Coupled Circuit Tuner and Detector 2-Stage Amplifier, is an ideal set for either phone or loud speaker use. Note that this set includes two stages of audio frequency amplification.

Complete Outfit, as above, wired—$35.50

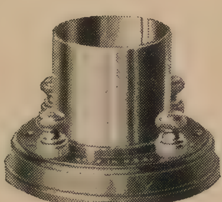


This instrument carries through the standard quality of ATWATER KENT products. For an open set it supplies a finished instrument unsurpassed in both appearance and performance.

Mounted Variometer—$10.00

The Type L Transformer is similar to that used in our high-grade Amplifiers and is mounted in a neat metal container with moulded condensite top which embodies the terminals. Its compactness makes it desirable where space is a factor.

Type L Transformer—$4.00

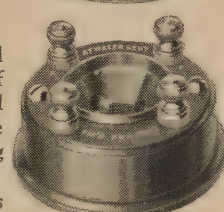


The ATWATER KENT Socket for the Standard Audion Tube has been designed in response to a demand for a dependable, high-quality socket. It's base is of moulded condensite.

Standard Audion Socket—$1.00

This socket has been designed to take the popular type of 1½-volt tube. The substantial moulded condensite base makes an excellent appearing unit.

1½-Volt Tube Socket—90 cents



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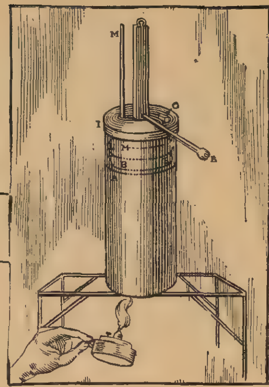
Radio Department 4937 STENTON AVE. *Write for Literature*



DENIS PAPIN'S STEAM CYLINDER

They Weighed Air—*and* Charles II Laughed

SAMUEL PEPYS says in his diary that Charles II, for all his interest in the Royal Society, laughed uproariously at its members "for spending their time only in weighing of air and doing nothing else since they sat."

This helps to explain why Charles has come down to us as the "merry monarch."

The Royal Society was engaged in important research. It was trying to substitute facts for the meaningless phrase "nature abhors a vacuum," which had long served to explain why water rushes into a syringe—the commonest form of pump—when the piston is pulled out.

Denis Papin had as much to do as anyone with these laughable activities of the Royal Society. Papin turned up in London one day with a cylinder in which a piston could slide. He boiled water in the cylinder. The steam generated pushed the piston out. When the flame was removed, the steam condensed. A vacuum was formed and the weight of the outer air forced the unresisting piston in.

Out of these researches eventually came the steam engine.

London talked of the scandalous life that King Charles led, and paid scant attention to such physicists as Papin, whose work did so much to change the whole character of industry.

The study of air and air pumps has been continued in spite of Charles's laughter. In the General Electric Company's Research Laboratories, for instance, pumps have been developed which will exhaust all but the last ten-billionth of an atmosphere in a vessel.

This achievement marks the beginning of a new kind of chemistry—a chemistry that concerns itself with the effect of forces on matter in the absence of air, a chemistry that has already enriched the world with invaluable improvements in illumination, radio communication, and roentgenology.

General Electric Company
General Office Schenectady, N.Y.

95-632D

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Certainly modern invention—modern engineering skill and organization, will prove more than equal to the demands of the architecture of the future.

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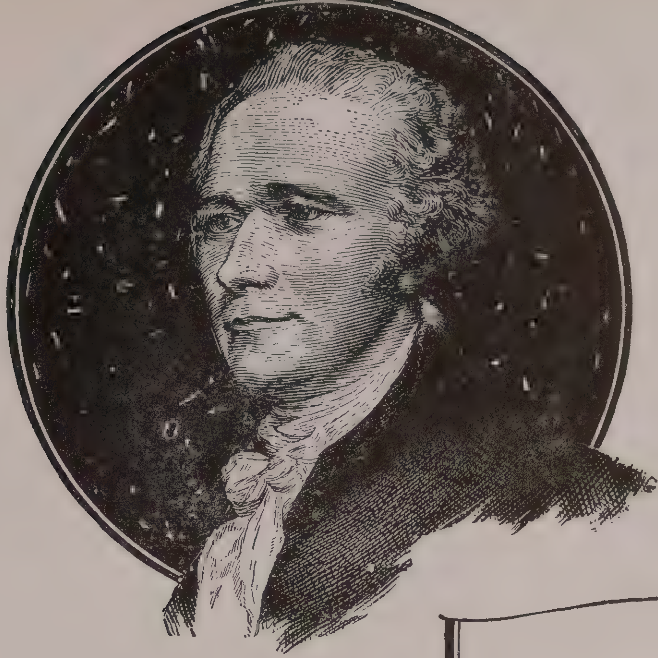

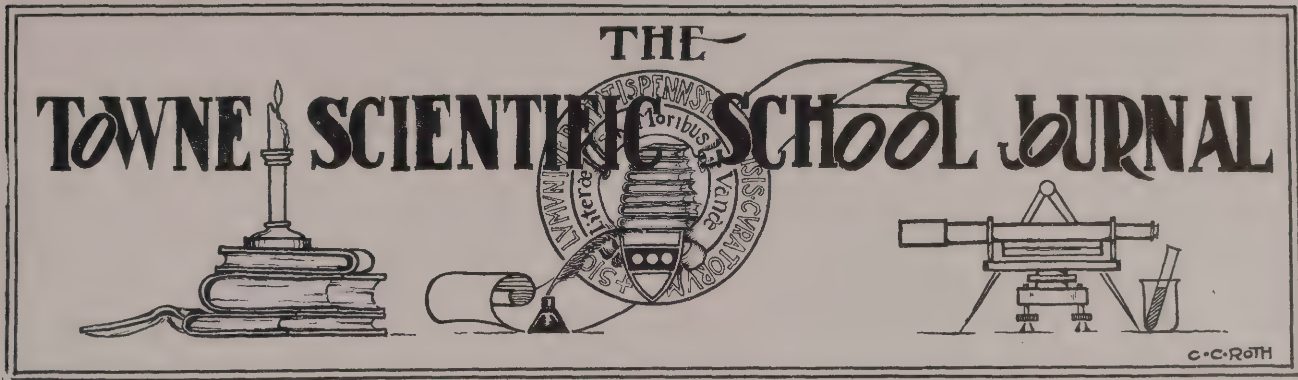

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Advertising rates upon application.

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Cake Eater

—model of 1900

He was called dude and dandy then, but you recognize the type.

He majored in haberdashery and took his degree with honors in soxology.

As if that were not enough, he evolved some variations on the cake walk which made them stare.

He even found time to develop a remarkable proficiency on the tandem bicycle, and on Saturday nights he was good enough to bring pleasure into Another's life by wheeling away to the "Ten-Twent-Thirt."

To crowd all this into four short years would seem enough for any mortal. Yet in spite of his attainments there are times, in after life, when our hero wonders.

The glory of his waistcoats has long since faded, while his books are still fresh and clean. Did he perchance put too much thought into the selection of his hats and too little in what went under them?

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

Western Electric Company

Since 1869 makers and distributors of electrical equipment

Number 28 of a series

THE TOWNE SCIENTIFIC SCHOOL JOURNAL

VOLUME VI | MAY 1923 | NUMBER 4

How to Succeed in Business

BY CHARLES M. SCHWAB

Chairman, Bethlehem Steel Corporation

AS TIME goes on I find it more difficult to speak of retiring from my forty-three years of business life. In fact instead of retiring I find myself drawn more and more into concerns, each of which involves new responsibilities. But the greater the responsibilities, the less I find of the element of personal supervision and the less I enjoy my new work. The thing that has given me the most pleasure and that I am the most proud of is that I keep finding friends, and friends—and yet more friends on every hand.

You want me to tell you how you can succeed in life. I know that it is very difficult to convince the great majority of people that men who are in active pursuits of life have any other object in view than the making of money. That is a great mistake. The real leaders of industry and the real men in life, and the real successes in life, are not always the men who have lots of money or a great fortune.

My idea of the successful life is the man who has successfully accomplished the objects for which he set out, to do something that is worthy of a real American man. Money is often a matter of chance or good fortune, and is not the mark of a successful life. It is not the thing that brings a throb of pleasure or a thrill into my life. And I would not pose as a successful man if that was to be the measure. But when I look about me and see the multitude of friends that I have after forty years of business association with men, when I see the great lines of smoking stacks and blazing furnaces that have come into being because of my interests and activity in life, and when I see a work that I set out to do successfully accomplished and meeting the approval of my fellow men, then a real thrill comes into my heart and I feel that I have done something worth while. The money you do not think about as long as you have enough to pay your bills and keep your business going. The captains of industry do not keep on working for the sake of making money, but for the love of completing a job successfully. Men who typify the ideal business man in my mind are Mr. Carnegie, the elder Mr. Rockefeller, Mr. Baker, the younger Mr. Rockefeller, and Judge Cary.

One of the dearest friends that I ever had in my life, Andrew Carnegie, used to say to me when I went to him with my balance sheet and showed him how many hundred thousand dollars we had made that month or year "That's interesting, but show me your cost sheet That is the mark of successful manufacturing, how economically and how well you do a thing, not how much money you make in the doing of it. So, his mark—and he was a wise man—his mark of successful industry is my mark of a successful life. Set out with some definite purpose in life and accomplish that purpose. There is little that the human mind can conceive that is not possible of accomplishment. The thing to do is to make up your mind what you are going to drive for, and let nothing stand in the way of its ultimate accomplishment.

Now, in my long experience in business life and association with men, there are some fundamental things that must not be overlooked. If I were asked to say the most important things that lead to a successful life I should say that, first of all, was integrity—unimpeachable integrity. No man can ever do anything of any great value in life and have the confidence and approval of his fellow men nor be successful in his undertakings with other business men if he doesn't have the reputation of being a man of honor and integrity.

I am going to speak of a young man that I regard as the most successful young man I have ever known. And if I did not regard him as the most successful young man that I know, he would not be the President of the Bethlehem Steel Company. I am going to speak

of a young man that I have known since he was a man your age—I refer to Eugene Grace. You may have heard of him. He came from Lehigh University. When I first knew him he was a shoveler of coal with an electric crane. I followed his career on and on and on. And whatever may have been said of Mr. Grace you could always depend upon it absolutely that when Mr. Grace said a thing you knew the absolute facts, good, bad or indifferent. And, today, Mr. Grace stands among the great business men of New York and this country, with the reputation of being a man of absolute integrity and a man in whom everybody can place the greatest possible confidence.

A man must also be a true democrat, and not an aristocrat who condescends to talk with anyone. The educated man must not get the idea that education necessarily makes him superior to any other skilled man who has devoted his life to mastering one business.

When I first entered the business world in 1879, the United States was producing only one million tons of steel a year; now we produce fifty million. Never was the opportunity and the reward so great as it now is in this reconstructed era. The hardest struggle of all is to be something different from what the average man is. I don't believe in "super-men," for the world is full of capable men, but it's the fellow with determination that wins out.

Bet on the United States if you must bet at all, for any good enterprise in this country is worth more than six or seven per cent. Put your all into any business which depends for its success on your own brains and determination to win. Be not fearful in borrowing money; I have borrowed more money than any other man in the United States and on less collateral.

Be sure to go into a business that will keep your interest, for you can't handle working men successfully if you only pretend to be interested in them.

If I were able to give you whatever I wanted, I would wish that you might have a rugged constitution, a desire to work, and the great American characteristic of driving onward.

Any man who goes into anything in life and does it better than the average will have a successful life. If he does it worse than the average his life will not be successful. And no business can exist in which success cannot be won on that basis.

Another important thing is loyalty. Be loyal. What measure of success I may have won in life I attribute to the loyalty I had for a dear old friend who was my first steel master, whom you perhaps have never heard of, Captain Bill Jones.

Captain Jones was a great mechanic, just a natural genius at mechanical things. No education at all. He knew nothing of engineering or chemistry or the sciences. Now, I was thrown in, fortunately, with him. I made up my mind that I could be very useful to that man by learning things that he could not learn, and, above all, by being loyal to him and never letting the world know that the things for which he received credit were not his own creation. Did you ever stop to think that a great man in life who has won great acclaim and great reputation is the very man who is willing to share and give the honor to others in the doing of the things that made him great? The man that will selfishly stand alone and proclaim that he is the man who has done these things never is the man who really did them. My own experience is that there is no real effort in life that is not done better under encouragement and approval of your fellow men. A man goes along then with greater confidence. You must learn to let others share with you in that which you are doing, and honor and credit will be reflected upon you for so doing.

Marshal Foch, the great commander, once said to me: "This great military staff is like an orchestra, and each one fills his place. Each is equally important in the functioning of the whole. If the baton is in my hands it is merely a matter of chance, but we shall see to it that each man in this staff gets recognition for that which is due." You never heard a great man say, "I did this," or "I will do that."

In the management of my great enterprises I have yet to find fault with any man. If a man is such that you must find fault with him to get the best out of him he is not a man to be desired in an organization. Show me the man that will do his best under approval, and I will show you the man that has within him the elements for successful going ahead.

Now, to come back to loyalty. Be loyal to the people with whom you associate at the start. When this good Captain Jones came to the end of his life's work, do you not suppose it was worth more to me than anything else to have him say: "That is the man that helped me do these things"? Remember always that it will but attract attention and credit to yourself to share it with those who help you. Be loyal when you start life wherever you start. Make your employer feel truthfully that you are sincere with him; that you are going to promote his interests; that you are going to stand for the things he represents; that you are proud of being a member of his staff, and there is nothing that will reap you a richer reward. Loyalty above all!

There are other things in life than mere work. I believe an appreciation of the finer things in life, the learning to know the beauties of literature and art and music, will help any man in his career. A man to carry on a successful business must have imagination.

He must see things as in a vision, a dream of the whole thing. You can cultivate this faculty only by an appreciation of the finer things in life. No active business life, whether it is manufacturing or something else, should prevent you from enjoying the beauties of life. These finer things will contribute to your success.

Be friendly. When you have friends you will know there is somebody who will stand by you. You know the old saying that if you have a single enemy you will find him everywhere. It doesn't pay to make enemies. Lead the life that will make you kindly and friendly to everyone about you, and you will be surprised at what a happy life you will live.

I want to tell you a little more about this man Grace, because one often sees the points in a successful life best by analyzing a single individual. I told you of his great faculty of making good, no matter in what position he was placed. This boy went on and on. Above all, he worked hard with the brain that had been trained in the university to think and concentrate upon the subject that he was thinking about until he had reached a satisfactory conclusion. Now, that is the great point, to concentrate and think upon the problem in mind until you have reached a satisfactory conclusion in your own mind, and then finally go ahead. If you have made a mistake, all right. Never find fault with a man because he has made a mistake. It is only a fool that makes the same mistake the second time. I tell a story of my own experience with Mr. Carnegie, as showing what this might mean.

As chief engineer of the works I had just built a converting mill. I went to him and said to him: "If you will give me the money to build this mill I can save 50 cents a ton." Of course he provided the money, and the mill was built. He came out to see it. I walked around with him. He saw the look of disappointment in my face and said: "Charlie, there is something wrong here. What is it?" I said: "It is exactly what I told you, and it is better than I told you. We save more than I said. But I don't mind saying that if I had to do the whole thing over again I would do it so and so. I made a mistake in that particular." He said: "Can you change it?" I said: "No." He said: "What does it mean?" I said: "It means tearing it down and doing it over again." He said: "Go ahead and do it. Don't make the same mistake a second time." Do you suppose if he had been a fault-finding man I ever would have told him? Not at all. He brought out the best in me. When that mill was torn down and a second took its place it was as great a success over the first as the first had been over the old one.

Mr. Carnegie had my confidence, and I had his confidence. He believed in everything I had told him. If I had told him something that was wrong and not admitted my mistake he would never have helped me to progress, and his works and his great establishment would never have progressed as they did.

Now, in my own establishmeny tou will be interested to know something about how we do things. You boys will all probably have to start to work upon a salary. But the quicker you get out of working for a salary the better for all concerned. In our works at Bethlehem and San Francisco, and all over the United States, I adopted this system: I pay the managers of our works practically no salary. I make them partners in the business, only I don't let them share in the efforts of any other man. For example, if a man is manager of a blast furnace department he makes profit out of the successful conduct of his department, but I don't allow him to share in the prosperity of some other able man in some other department of the establishment. I give him a percentage of what he saves or makes in the department immediately under his control and management. For example, if it takes a dollar a ton to make pig iron, and it takes him a dollar a ton to make pig iron, I say to him:

"Well, you are no better than the average manager over the country. Therefore you are entitled to only the usual wages. But if you can make pig iron at 90 cents a ton you are entitled to share with me in a large part of the profits. And if you make it for 40 cents or 50 cents a ton you share to a very large degree."

Therefore I don't care how much a man earns. The more he earns the better I like him. And I pay in what I call bonuses to the various superintendents and managers of the different establishments more money for their successful management than I pay to the stockholders of the concern in dividends. And it will surprise you to know the great sums of money that some of these men make. I would be afraid to tell you for fear of discouraging you in your start in life. But I don't mind saying that forty, fifty, sixty, a hundred thousand dollars a year for these men is not infrequent. And in the case of men like Mr. Grace, well, many, many times that.

If you have any influence in the world to get you a start in life, don't use it. The worst thing that can happen to a man is to start life with influence. He has got to do twice as well as the fellow that starts upon his own merits, because, after all, it depends on the general opinion of all those around you as to how competent and successful you are, and when everybody says that

(*Continued on page 24*)

Some of My Experiences in Germany During the War

By C. R. Meissner, E. E. '23

WITH these lines I do not intend to remind you of those days and events of the Great War that we all try to forget, but rather to give you an idea of some of my personal experiences during and immediately after the great calamity.

The memory of those fateful first days of August, '14, is still as vivid as if months and not years had elapsed since the news of "war" struck awe and terror into our hearts. We could hardly believe it. True, there had been rumors, but we had discredited them; there had been prophecies, but we had shrugged our shoulders. Living in a city like Hamburg where shipping and commerce seemed to link us closer to the wide world that lay beyond the German boundary, where the cosmopolitan spirit of international business was more evident than petty politics, it seemed impossible to realize what war would mean and what would be the outcome in the far future.

A very interesting feature was the reaction of the people to the scarcity of supplies which followed the days of mobilization when all trains and cars were requisitioned for the use of the military. There were those who for sheer patriotism and bravado regarding it as their national duty to take things as they came and living up to their theory made no attempt to fill their pantry with meat and flour and sugar; then again there were those, and they were the great majority, who lived up to the old saying: every one for himself and the devil take the hindermost. In time our storerooms began to look appallingly empty and it was then that I had my first experience of what it means to stand in line and wait for hours, perhaps, for the distribution of flour, butter and cereals. People would come as early as six o'clock in the morning bringing little campstools with them, so as to be the first in line when a shoe store would open at 9 A. M. for otherwise, and this would happen inevitably before all the eager demands were filled, the door would be slammed in our faces—the supply had given out. Police were always necessary to keep order and prevent riots among those who had to be turned away whenever and wherever any articles of clothing were sold at what was advertised as a "reasonable price" "A reasonable price" for a pair of shoes was considered by the trade to be 200 marks at a time when a teacher was receiving a monthly salary of 250 marks.

In the fall of 1916 I graduated and as I intended to take up electrical engineering I had to comply with the college rule which required two years' shop work before matriculation. I started as apprentice in one of the shops of the Telefunken Co., the most important German concern of their line of manufacturing and installing wireless apparatus. Their branch was located in the Free Harbor, a large section of the city's harbor facilities set aside for bonded trade and heavily guarded by a custom ring. A pass is necessary to enter or leave any part of it.

An item that may prove of interest and which at the same time throws a light on the labor situation of the big industries during this period, is the fact that I, merely nineteen years of age and with little practical experience, was put in charge of the 2000 Kw—D. C. switchboard and machine room which supplied the greater part of the Hamburg harbor with power and light. This main switchboard really consisted of thirty individual switchboards each representing one of the large consumers depending on us for their supply of electrical energy. The scarcity of copper and brass, for every thing that could possibly be replaced was requisitioned for manufacture of munition and their subsiquent substitution by iron and zinc frequently caused serious trouble, cutting off the entire power for the whole district.

Once, and this was soon after I took charge of the switchboard, I received a severe shock. I had just thrown a customer's supply switch and had stepped aside when blinding as a streak of lightning a spark shot across the board, a roar like thunder, the smell of burning insulation and metal and when I looked to see what had happened one of the main switches had disappeared, literally "gone up in smoke." This and other accidents were due only to the poor insulating properties of rubber substitute and their inadequate mechanical strength.

I continued to hold my position with the Telefunken Co. after we entered the war, in fact our severing relations with Germany had no influence whatsoever on my daily work. In time I was given charge of wireless repair work and it was in this capacity that I, an American citizen of military age, was ordered to do repair work on a German battle ship laid up in

(*Continued on page 34*)

DURALUMIN

L. N. Gulick

Assistant Professor of Mechanical Engineering

IF YOU can but visualize a metal one-third the weight of brass, but with approximately the same strength as cold rolled steel, your picture will be realized in the new alloy—Duralumin, manufactured by the Basch Machine Tool Company.

Although originally developed abroad for use in the construction of Zeppelins, the product has been perfected in this country to a point far in advance of the German product. The analysis is given as—

Copper 3.50—4.00 per cent.
Magnesium 0.20—0.75 per cent.
Manganese 0.40—1.00 per cent. with 99 per cent. pure aluminum making up the balance.

Despite the fact that Duralumin costs approximately five times as much as steel, it is still true that only one-third the number of pounds will be needed to give the same effective strength. Also the alloy possesses many desirable features not found in steel. For one thing, every pound of structural weight saved in an airplane or airship means one more pound of fuel or other form of load can be carried. Another point greatly in favor of Duralumin is that it is much easier to work than steel so that its use results in a great saving in tool cost and labor. In many cases, it is cheaper to construct of Duralumin than of steel for this reason alone.

The recognized physical characteristics of Duralumin are obtained only after heat treatment and in this state the metal will withstand only slight forming operations.

Where severe forming or deep drawing is required, it is necessary that the user either heat treat and form before aging takes place or use annealed stock. If annealed stock is used, the finished pieces may be given heat treatment after working, thus obtaining the maximum physical characteristics of the alloy in the finished piece.

Conversely, heat-treated Duralumin may be annealed for drawing and forming and, when this is done, it is entirely practical to again heat treat, the original characteristics of the alloy being again obtained.

Duralumin may also be annealed between drawing operations where necessary.

The heat treatment consists of a single heating and quench followed by a period of aging, no drawing or double treatment being necessary. Electric or coal, gas or oil fired, muffle or semi-muffle furnaces are all satisfactory when properly controlled, or the nitrate bath may be used. Basch Duralumin cannot be successfully heated in an open flame as it damages the metal and, as the heat treating and annealing temperatures are below color range, pyrometer control is essential.

It is recommended when furnaces are used, they be up to and holding the quenching temperature before the metal is put in. After charging, the furnaces should be gradually brought back to temperature and then held there for twenty minutes or longer depending upon the sections and the amount of metal in the charge. The metal should then be immediately quenched with a minimum temperature loss. The quenching temperature is from 950 to 960 degrees Fahrenheit, and uniform and satisfactory results will be obtained with the usual allowable temperature variation of 10 degrees Fahrenheit, plus or minus. The quenching medium may be hot water, 100 to 212 degrees Fahrenheit, or ordinary quenching oil at the same temperature. As the maximum properties of Basch Duralumin are not reached immediately following the quenching, it is necessary that the metal be allowed to age for at least forty-eight hours before making tests, for physical properties. This aging should take place in a warm room at a minimum temperature of 70 degrees Fahrenheit. Higher temperatures, up to 212 degrees Fahrenheit, accelerate the aging period but do not commercially affect the results.

The same furnaces may be used for annealing and the best temperatures are from 680 to 700 degrees Fahrenheit. The length of time the annealing temperature is held and the time allowed for cooling affect the degree of anneal, soaking at the annealing temperature and slow cooling being essential to obtain the softest anneal.

It has also been found that the metal is unaffected by mercury, is non-magnetic, withstands atmospheric influences, and offers a remarkable resistance to the action of sea or fresh water. It is only slightly affected by numerous chemicals which in the ordinary way so readily corrode other metals and alloys.

It also takes a polish equal to nickel plating and remains bright longer than any plate or silvered article.

It is in addition, an excellent substitute for aluminum, German silver, brass, copper, nickel-plated and silvered articles.

Comment on the Year's Work

By C. E. Clewell

Dean Pro Tem. Towne Scientific School

IT IS possible at this time to comment briefly on the work of the current year, 1922–23. First and perhaps foremost, mention should be made of the splendid spirit of co-operation among the student body of the Towne Scientific School. Following a slight irregularity last Fall after one of the football games, members of the Senior Class pledged themselves to exert every effort to make the Towne Scientific School stand out on the campus as having high ideals in conduct and general deportment. The results of the present year more than bear out these good intentions and reflect credit upon the entire student body.

The commendable attitude of the student body towards the assembly or recreation room on the second floor of the Engineering Building, should also be mentioned. Every one wants to keep this room in excellent order so as to reflect favorably the general student decorum, and now that the furniture has been repaired, through the great kindness of an Alumnus, Mr. David Halstead, Class of, '95, each man will take particular pride in the maintenance of this room as one of the notable institutions of the building. Each of us will also take sincere pride in our personal conduct in the halls and in class rooms, and in the preservation of the building throughout, as a thing which has been entrusted to our stewardship.

It would hardly be fair to avoid the topic of scholastic achievement. While the policy of the Towne Scientific School is to require each student to maintain his work at a high standard of excellence and to prevent the accumulation of conditions, this would be next to futile were it not for the underlying effort of the student body itself to live up to these standards. The number of students who have wilfully failed to do their duty in the class rooms and laboratories, has been notably small during the current year.

It is hoped that each loyal member of the student body will do his utmost between now and next Fall to let others know of the Towne Scientific School and of the courses of study which are offered here. Each student, moreover, for his own sake, should learn to take an interest in the ideals for which this Division of a great University stands: in the faculty, in the laboratory equipment, and in the general problem of administration.

There has been a very slight tendency for a few men here and there to reach wrong conclusions as to individual requirements imposed by administrative committees. This is not for the best interests of the several departments. Every case which comes before a committee receives individual and careful attention, and the requirements imposed are assigned on the basis of what the given committee thinks to be the best for the School and for the student. It is to be hoped that the student body will view the decisions reached by the administrative officers as rendered in a spirit of fair play and as based upon those high ideals which consider the ultimate well being of each student.

It is the earnest wish of the present incumbent of the Deanship that he may be able to return the office to Dr. John Frazer next September in the same state of high efficiency that he found it to have when he entered the office temporarily on June 1, 1922, and also that all those who have had occasion to come into contact with the Dean's office during the current year may be able to look back upon the experiences with none but pleasant memories.

Archeological Expeditions

Roy H. Borgersen, M. E. '26

THE study of the antiquities—the art and customs of the ancients—has always held a fascination for those who delight to mingle among the records and relics of former ages. The learned antiquary, seeking to uncover the art or to decipher the hieroglyphics of a people who have long since passed into the vista of oblivion, derives a peculiar satisfaction and pleasure from his labors: he discovers that the ancient races had attained a comparatively high civilization, and that in many ways their handiwork far surpasses that of the modern craftsman. Likewise the archeologist, mingling among the monuments of antiquity, is confronted with the evidences of a mighty civilization that existed at such an infinitely remote period that in the

light of time it is immemorial. Doubtless, we too, find this subject, and especially the archeological expeditions, all-absorbing in interest. Quite naturally, therefore, would the Commercial Museum be brought to our attention since it has been very active in archeological enterprise. Even now, the discoveries of so recent a date, centering about the "Valley of the Kings," in Egypt, recall to us the titular rôle which it has played within the last twenty or thirty years—a part which has thrust it into a position rivalling even that of the oldest museums of Europe.

Shortly after its inception, the Commercial Museum became the direct beneficiary and inheritor of the interest in archeological exploration of Charles Custis Harrison. This celebrated explorer organized and financed an expedition into Assyria. At the head of this expedition was Dr. John Peters, associated with the U. of P. and himself a noted archeologist. J. H. Haynes with Dr. H. V. Hilprecht rendered invaluable assistance to Dr. Peters, both in actual service and in recording the story of the entire expedition. The book, written by Hilprecht, contains many interesting personal incidents and also reveals the dangers, discouragements, and final success of this very noteworthy enterprise. In 1888 actual work was begun in excavating the ancient city of Nippur. The undertaking was a splendid success, and, to this day, is among the greatest achievements of American Egyptologists.

In the following eight or ten years numerous other expeditions were undertaken, but none approached that of Peters, Hilprecht, and Haynes, either in scope or importance. Unfortunately, for some time afterwards little interest in Egyptology was manifested in Philadelphia, at least no further important work was done. With the advent of the war, however, interest was suddenly revived. The occupation of Palestine by the English gave the Philadelphia forces working in Egypt an unexpected opportunity. They were immediately transferred to Bei-San, the ancient Beth Shan of the Bible, south of the Sea of Galilee and west of the Jordan, where after having sunk a shaft there was revealed the rich treasures of seven subterranean cities. The buried cities lay one upon the other and were still in a good state of preservation. Investigation revealed the marble sarcophagus of Antiochus, cousin to the Biblical Herod, besides the renowned Philistine burial ground. Ur of Chaldee, a place from whence issued Abraham, the founder of the Hebrew race, is now being excavated, under the supervision of M. C. Wooley, who is working jointly with British authorities.

Naturally enough, the Western Continent did not escape the attention of the archeologist. The wealth of material offered through a study of the Aztecs and Incas, in Peru, attracted the notice of several eminent men.

Other and more numerous expeditions were sent out by the University to more remote lands. Lieutenant Van Valin, thrilled with the spirit of adventure, braved the rigor of a frigid clime to study the Arctic peoples. Into the Celestial Kingdom C. W. Bishop journeyed, studying ancient Chinese civilizations, while the memorable Hilprecht visited Mt. Pelee in 1902, and witnessed the eruption of this great but ruinous volcano. Into the icy regions of Labrador, in 1891, went Harry G. Bryant, with a little band of brave men. The discovery of the Grand Falls of Labrador so encouraged this Arctic explorer that in 1897 he undertook a second expedition to Mt. St. Elias. Allured with the tropics, Clarence Bloomfield, almost fifty years ago, journeyed to South America, crossing in the course of time, these lofty mountains and later cruising down the swift waters of the Amazon. The present time finds this noted exemplar of discovery still in the Southern clime, studying the ancient Indian mounds.

The Commercial Museum has been the direct beneficiary of these many expeditions and explorations. Within the vast edifice are housed many valuable and priceless exhibits. Among the irreplaceable possessions of the museum is one, which unfortunately for lack of proper space, has not been exhibited for public scrutiny. This is a funeral chamber—Rokapou's tomb as it is called—which resembles in many ways the recently uncovered mortuary chamber of Tutankhamen. The walls of the tomb are of limestone, on which are found, still in perfect condition, the hieroglyphics and bas reliefs of the ancient Egyptians. The greater part of the internal wall of the tomb is covered with inscriptions denoting the exalted ancestry of Rokapou, who was one of the kings of the celebrated Pharaoh dynasty. In the center of the chamber reposes a granite sarcophagus, about which there has been much conjecture. These valued treasures, however, are but a few of the many relics which are preserved with the utmost care within the auditorium of this vast building. Each passing year finds the museum richer and greater—richer in actual wealth and greater in the eyes of the world.

With the glory and renown of this museum are blended the illustrious names of those men through whose achievements the university entered into its greatness. These men will never be forgotten, for their names will stand as beacon lights impelling others to follow in their footsteps. Thus will the glory of Pennsylvanian achievements ever transcend that of any other institution.

EDITORIALS

Engineering College Magazines Associated

AT THE recent convention of the Engineering College Magazines, Associated, held at the University of Illinois, the TOWNE SCIENTIFIC SCHOOL JOURNAL, after a probation of nearly a year, was admitted as a full-fledged member of the Association, along with *The Penn State Engineer*.

The election of the JOURNAL to this body was one of the greatest honors that could be conferred upon the magazine, because this organization is composed of the foremost student engineering journals in the country. Consequently, this recognition places the local paper on an equal basis with the other large technical journals.

An effort has been made in the last few years since the rebirth of the JOURNAL as the official organ of the students of the Engineering School, to make it equal to that of similar schools. Steady improvement in appearance and reading matter have been made by following the suggestions offered by the members of the school who were interested in the undertaking, until now the paper is in a position to represent the School and should be looked up to as the real organ of the various groups and societies that compose our Engineering School.

The Association was formed in the last few years by several of the larger technical magazines, and now has as its members the following list of publications, besides several papers which are serving probation: *Colorado Engineer, Cornell Civil Engineer, Illinois Technograph, Iowa Engineer, Iowa Transit, Kansas State Engineer, Michigan Technic, Minnesota Techno-Log, Nebraska Blue Print, Princeton News Letter, Rose Technic, Sibley Journal, Tech Engineering News, Wisconsin Engineer, Virgina Journal of Engineering, Penn State Engineer*.

The Senior Trip

OUR Senior Mechanical, Chemical and Electrical Engineers have just returned from their respective inspection trips, full of enthusiasm and with better understandings of their chosen vocations. That the trips were a success there is no doubt.

The senior trip is perhaps the biggest thing that comes in the four years of the student's college life. He meets men who have done what he intends to do and who have made a success of it. He studies their methods, their personalities and their field of work. It is these contacts with men in the field that enable him to see, more clearly than anything else, the inside workings of the engineering game. Then again he may be enabled to decide which of the many industries that he sees, he would rather follow upon his graduation. This in itself, if a wise decision is made, is an invaluable result of the trip. It broadens him like nothing else he obtains in his entire school career.

But, besides the technical knowledge that he gleans, he learns to observe men and study human nature a little more closely; a very important factor in business life. He strengthens the foundations of his friendships among his own classmates, by living with them and being with them in a new and varied environment.

It is regrettable conditions are such that the senior trips cannot be made more extensive, for the benefits derived are far reaching and will never be forgotten.

The New Power Plant

OUR campus is soon to be materially improved. What should be one of the prettiest spots on the campus, and which is now one of the ugliest, will soon come into its own.

The Board of Trustees of the University have decided to give us a new power plant. The site of the present plant will in all probability be occupied by an auditorium.

The exact location of the new plant has not been decided upon but it will be on the south side of South Street near the river. The details of the structure are also still problematical, only the main ideas having been worked out.

The steam and electricity that will be generated at this plant will be led up through a system of pipes to the present distributiong center at 34th and Spruce and distributed from there to all parts of the University. It is interesting to note that provision has been made whereby these pipes can be passed under the south side of our new stadium.

The Board of Trustees have appointed a committee to carry the project to completion. The members of this committee are Mr. Charles Day, Mr. Charles L. Borie, Jr., and Mr. Arthur L. Church.

Here's To

TOO much praise cannot be bestowed upon Prof. Clewell for his most excellent work as Acting Dean of the Towne Scientific School. It is not an easy task to take over the administrative reins of an organization like that of the Engineering School and keep all the works running in the same smooth channel that they were in before the change. Acting-Dean Clewell did all this, upholding the faith that the Board of Trustees had in him when he was honored by election to the office during Dr. Frazer's sojourn in France.

Undoubtedly one of the most important duties of the Dean of the Engineering School is that of playing a fatherly role to his students and it is in this capacity that he is best known to them. This entails honoring and praising the men doing good work but more often it is a case of the opposite kind. This latter case is undoubtedly an unpleasant duty for the Dean, about as unpleasant, the editor might venture to say, as it is for the unlucky student and it was in the fulfilment of this task that he showed he was a man and a friend. It is almost needless to add that he won the regard of all the students who were fortunate enough to meet him personally. THE TOWNE SCIENTIFIC SCHOOL JOURNAL here wishes, as spokesman for the entire student body, to compliment him on a piece of work well done.

Alumni

THESE few words are addressed to the Class of 1923—prematurely it may seem, since the Class has not yet received its sheepskin, but nevertheless the best way and time to say it. Straight from the shoulder, we want to strongly impress upon you the fact that as a true Pennsylvanian you are under obligations to join the Alumni Association; furthermore, that what is termed an obligation is really a privilege. Just the mere fact that a man can say after graduation that he is still connected to and a part of "Old Penn" seems wholly sufficient to warrant joining. In addition the pleasure of working side by side in years to come with your old schoolmates for your Alma Mater is something that older men have told us cannot be described in words.

So go to it '23, for it's you younger men who will be the leaders of the Alumni in years to come.

The Importance of Colloid Chemistry to Industry

By Harry N. Holmes

Chairman Colloid Committee of the National Research Council.

THERE is nothing mysterious about colloids. They are not new substances but merely ordinary substances with particles of special dimensions, ranging from approximately one to one hundred millionths of a millimeter. Such particles are a little larger than the largest molecules and yet just too small to be seen with definite diameter by the microscope.

Colloidal particles, then, are simply aggregates of a few hundred (more or less) molecules. With a somewhat greater degree of dispersion colloidal suspensions become true solutions. On the other hand when these colloidal units or aggregates coalesce into still larger aggregates, they may be precipitated from suspension. Unless such coagulated material becomes distinctly crystalline on standing, we are in the habit of calling it colloidal, as in the case of cheese for example.

From the theoretical standpoint, the chemist is interested in such topics as the preparation of colloids, their electric charge, coagulation, peptization, protective action, dialysis and diffusion, gel structure, surface tension, emulsions, viscosity, absorption of gases, absorption from solution and many others.

All the sciences, even astronomy, dealing with the colloidal dust of comet's tails, are dependent upon colloid chemistry for their full development. Physics with its surface energy problems, geology with diffusion through gelatinous silicic acid and fine powders, biology with hydrated plant and animal tissues, medicine with the study of hydration and diffusion in body tissues and peptization by digestive juices, engineering with countless colloid problems to solve—all eagerly watch the rapid growth of the young sciences of colloid chemistry.

The applications to the industries are almost universal, although all manufacturers are not yet familiar with this fact. When research chemists demonstrate convincingly to their employers the basic connection between colloid chemistry and industry, our manufacturers will finally come to a proper appreciation of the financial importance of this growing science.

Colloid chemistry is closely related to the problems of lubrication, agriculture, de-watering oils, purifying clays, catching offensive or wasted fumes, drying peat, de-inking old newspapers, concentrating ores, tannin baking, cooking, washing, dyeing, roadmaking, photography, water purification, sewage disposal; and one should know a good deal about colloid chemistry if he is to manufacture rubber goods, glass, porcelain, enamels, cements, alloys, fungicides and insecticides, dairy products, any cellulose ester materials, colloidal fuel, gelatine, glues, gas masks, adsorbent gels, paints, varnishes, soap, ink, oils, pencils, and crayons.

Theory and practice must go hand in hand. For example, wetting power—the ability of a liquid to wet a solid—is a property made use of in many technica processes, and one may blunder along in the application without adequate theory as a foundation. Nuttall (J. Soc. Chem. Ind. 39,7–73 1920) discusses this subject very clearly. For a liquid to spread easilyl in a thin film on a solid the liquid must have a low surface tension, a low inter-facial tension, and perhaps a high surface viscocity. Solutions of alkali soaps, with their low surface tension, have high wetting powers. But a solution of saponin with a comparatively high surface tension has excellent wetting powers due to its high surface viscosity. A 1% solution of saponin wets a sheet of paraffin although a 5% solution of soap does not.

Substances that lower surface tension, concentrate at surfaces or interfaces, sometimes in a film with the properties of a plastic solid as in the case of saponin. These films tend to prevent mixture and running together to form drops.

Thus saponin is a good emulsifying agent, as in an alkali soap, but for a different reason. The plastic film formed at the oil water interface interferes with the coalescence of drops. In milk the globules of fat are surrounded by a tenacious coating of adsorbed protein.

Foaming usually, but not always, parallels high wetting power. Saponin foams are merely plastic films resembling the "armor-plated" flotation froths.

In floation of ores we depend upon the fact that a little added oil wets the small particles of the valuable metallic sulfide better than does water, while the reverse

is true for the particles of "gangue" or waste rock. Thus, when finely ground ore is beaten with water carrying a very little of some special oil, the films of oil in the froth wet and float the copper sulfide (or other valuable sulfide). The froth is stabilized and stiffened by presence of this plastic film of sulfide particles. Removal of the froth gives a concentrate far richer than the original ore. Of course the gangue, being preferentially wet by water, sinks to the bottom of the tank. Quartz particles may be wetted even more readily by water if a little acid or base be added. This may be due to adsorption of hydrogen ion or of hydroxi ion. Since 60,000,000 tons of low grade ores are "floated" annually, it is evident that the topic of "preferential wetting" is worthy of study. Now it is proposed that fine particles of coal be separated from ash, or waste rock waste, by the use of a solution wetting the two materials in different degree.

Emulsions are dispersions of one liquid in another and are simply made by suitable mechanical agitation of the two liquids. However, the tendency of the two liquids to form two drops or layers thus presenting the minimum of surface is so great that to prevent coalescence of minute drops a third substance called an "emulsifying agent" must be present. As a rule the emulsifying agent is colloidally dispersed in one of the liquids; for example, an alkali soap in water. Such alkali soaps aid emulsification by lowering the surface tension of the water as well as by forming concentration films around the oil globules. Saponin, on the other hand, is a good emulsifying agent, in spite of the comparatively high surface tension of its aqueous solutions, because it concentrates at the oil-water interface to form a plastic film.

With alkaline earth soaps the oil is not dispersed in drops in water (the usual type of emulsions), but water is dispersed in drops throughout the oil (the unusual type, a water-in-oil emulsion). This because alkaline earth soaps are more soluble in oil than water. A rule applicable here is that if the emulsifying agent is more readily peptized by liquid A than by liquid B, it will be B that is dispersed in drops. This is even true in the case of insoluble fine powders which are more readily wet by A than by B.

Industry needs emulsions and makes them, but industry is also concerned with breaking certain annoying emulsions. To attack such a problem one must first learn what the emulsifying agent is. It may be a soap, a glue, a gum, a fine-grained sludge or a sulfonated oil. In any event it must be removed or converted into some other substance. Addition of acid to a soap is effective because this liberates the fatty acid, a poor emulsifying agent. A dehydrating agent may ruin the effectiveness of a highly hydrated emulsifying agent. Since oil particles carry a negative charge of electricity, they may coalesce if this charge is neutralized by ions of high positive charge such as Al^{***} or Fe^{***}. Also, if the droplet charge is almost neutralized by addition of a suitable salt, the emulsion may become so unstable that filtration through proper material will completely separate oil from water.

Lubricating greases are emulsions of 3–5% water in a soap oil system. The soap, usually a calcium soap, although aluminum soaps are also in use, is dissolved in the hot oil, a heavy petroleum fraction. The mixture is stirred while cooling, and the water added below 100°. Separation of oil from soap on long standing is checked by the presence of water droplets. It is probable that some alkali soap is added to increase the viscosity of the water droplets. Cheaper greases are made by the use of soaps of the resin acids.

Nuttal, in his fine paper already referred to, points out that a disinfectant must wet the surface it is intended to disinfect. Chick and Martin (J. Hygiene, 8, 698–703) believe that with coal tar disinfectants the bacteria are absorbed on the emulsified particles of the tar acid, thus being brought into contact with disinfectant in a most concentrated form. Sprays must wet green leaves. "By incorporating an oil emulsion with the dip, and thus ensuring high wetting power, Cooper showed that it was possible materially to reduce the sodium arsenite content of the dip and yet ensure the destruction alone of the tick without injury to the cattle. This application alone of wetting power has been instrumental in clearing large tracts of tick-infested country in various parts of the world."

Wetting power has been discussed here in some detail as an illustration of what any chapter in colloid chemistry may lead to if applied as carefully. Space lacks for an adequate discussion of the enormously important topic of adsorption.

Adsorption of toxic gases by cocoanut charcoal is familiar to all after the experiences of the great war. Yet the application of the principles of gas adsorption by activated carbon, silica gel, etc., is now a peace time matter of great commercial importance. Silicic acid, formed as a gel, washed and dried to a content of 18% or less, is a glassy material shot through with innumerable capillary pores of diameter not much greater than that of molecules. In these capillary pores gases are brought well within the range of molecular attractive forces and so are held or "adsorbed." This adsorption is preferential for various gases but it may be mentioned that such a "gel" is a powerful dryer, that it removes gasoline from casing head gas, and that it removes

(*Continued on page 26*)

TOWNE TOPICS

TOWNE SCHOOL STUDENTS HEAR ADDRESS BY NOTED ENGINEER

Through the efforts of the Vocational Guidance Committee, a talk on the comparison of various professions was given in the Houston Club.

Professor Robert H. Fernald, who presided, introduced after a few remarks Rev. "Jack" Hart, the head of the committee. He explained the aims of the lectures, which are to present the advantages and requisites of the various professions.

John L. Harrington, the president of the American Society of Mechanical Engineers, was next presented by Professor Fernald. Mr. Harrington, who is a graduate of the University of Kansas, is a noted engineer, having constructed many important bridges both in this country and abroad. In his talk he stressed the need of a liberal education for engineering students, rather than a strictly technical one. He showed that the engineer was the greatest carrier of ideas and good feelings among the peoples of the world and should therefore have an education that will fit him for this duty.

A clever definition of an engineer as Mr. Harrington gave it was "a man who does for one dollar what other people do for two." He brought out the little known fact that engineering is the highest paid of all the professions, although the most important positions do not give as great a remuneration as in law or medicine.

L. W. Wallace, the secretary of the American Federation of Engineering Societies, followed Mr. Harrington with a discussion of the fields of service for the engineer. "People believe now that the great work of the engineer is finished but this is incorrect as the field and problems to be overcome are greater than ever. Industrial leadership, the relation between industry and the public, labor, standardization of products, elimination of waste are only a few of the many difficulties to be solved."

TAU BETA PI

Tau Beta Pi announces the following pledges:

E. S. Eldridge
J. J. Ashton
H. L. Nelson
L. E. Weisbecker
J. M. McIlvain
R. G. Kraus
A. F. Samuel, Jr.
H. F. Houghton

The chapter will hold its Spring initiation on the 24th of April. This is to followed up by a reception for the newly elected members.

Terms of the present officers end this year:

President—F. Outcalt
Associate Editor—N. H. Smith
Vice-President—J. Bodle
Secretary—Wm. Lipp
Corr. Secretary—J. Geoghegan
Cataloger—H. Reiner

These men have been active in the interests of the Tau Beta Pi for the past two years. The election of the new officers will take place sometime in May.

MEN ABOUT TOWNE CLUB

At a recent meeting elections for the 1923–24 years were held, with the following results:

President—Jenkins, M. E. '24
Vice-President—Parker, M. E. '24
Secterary—Thoenebe, M. E. '24
Treasurer—Rife, M. E. '24
Manager—Allman, Ch. E. '25

All these men have been active in producing previous shows and are looking forward to next season's production. Tentative plans are already being laid and much will probably be accomplished during the summer vacation, enabling work to be started immediately upon returning to classes in the fall.

ALPHA CHI SIGMA

Initiations were held in March and nine undergraduates and one Faculty Member were admitted to the chapter. At the present time permanent accommodations in the Harrison Laboratory are being sought. Interest in the fraternity is increasing; its activities are being widened and it has assumed a definite place in the chemical department. Several lectures have been held in conjunction with the Priestley Club, and the purchase of valuable reference books for general use will soon be started with a view toward establishing an independent chemical library.

At a recent E. E. seminar, Mr. Mills of the Western Electric Co. gave a very interesting talk on "Communication."

HONORARY SOCIETY ELECTS NEW MEMBERS

At the bi-monthly meeting of Sigma Xi fraternity eight graduate members and seventeen undergraduates were elected associate membership.

Those elected from the graduate school are:

Filo Rufus Clare, A. B.
Isaac Clyde Cornog, A. B.
Charlotte Easby, A. B., A.M.
Howard Ross, A. B.
Rudolph Gustav Schmeider, A. B., A. F.
Sydney Seigfried Schocket, M. D.
Walter James Seeley, E. E.
Lila Amelia Wierbach, B. S., A. M.

The undergraduates elected to associate membership are:

Martin Theodore Glass, C. E.
Thomas Casselberry Benton, Math. A. S.
Douglass Gordon Braik, Arch.
Julian E. Bodle, Ch.
Joseph Ellsworth Brown, M. E.
David Collins Cleland, Arch.
Thomas Elwyne Cushing, M. E.
Edgar Stites Eldridge, Ch. E.
George Francis Frederick, Arch.
John Joseph Geoghegan, Ch. E.
Harry Richard Halloran, C. E.
Harry F. Huf, Ch. E.
Ralph Edgar Irwin, E. E.
Roy Frank Larson, Arch.
Joseph William Lipp, Ch.
Houston Randolph Paxson, E. E.
Nicol H. Smith, Ch.

HEXAGON

The Hexagon Society announces the following elections:

D. Beard, M. E.
D. Wagner, C. E.
H. Walker, M. E.
O. Manz, E. E.
J. Hewlett, M. E.
J. Lindsay, C. E.

E. C. FRANKLIN

On the evening of April 12, 1923, the Philadelphia Section of the American Chemical Society met at the Harrison Laboratory. The four hundred technical men and students who filled the theater had the extreme good fortune to hear the interesting address given by Dr. E. C. Franklin, of Leland Stanford University, recently elected President of the American Chemical Society. The topic was "Liquid Ammonia," and the subject-matter was presented in such a logical and pleasing manner that Dr. Franklin had little difficulty in holding the intense interest of his audience. He showed that liquid ammonia is neutral to indicators, that it has nearly all the properties of water, both physical and chemical, except that it exists as a liquid at a low temperature, and conducted experiments to substantiate his theories. Among the most interesting of these was his proof that ammonia is a non-conductor of electric current, if no electrolyte is present, and that most salts which suffer "hydrolysis" also suffer analogous "ammonolysis." He showed, too, that by such reactions, especially in the case of certain organic compounds, substances of commercial value could be formed, and indicated the big field which lay before experimenters.

On March 27th, 28th and 29th the senior chemical engineers and chemists under the guidance of Dr. Shinn, took their annual inspection trip.

At Northampton, Pa., The Atlas Portland Cement Co. was visited, and at Palmerton the New Jersey Zinc Co.

In and around New York City such modern and up-to-date plants as the Corn Products Refining Co., the Squibbs Chemical Works, Jones Bros., and the Westinghouse Lamp Works were visited.

At the latter place the fellows were treated to a lunch. They have a self-service cafeteria here and the fellows didn't know until they had their checks totaled that the lunch was free. It is thought that had certain fellows known this they would have eaten more than they did.

After lunch the dance floor was opened to the boys and they were invited to dance with the girls, which they did. Several nearly missed their train on this account.

On the afternoon of the third day of the trip the class had the opportunity to display their prowess as Alpine climbers.

It is hoped that next year's class will be prepared for such a treat and will eat and act accordingly.

The annual dance of the Civil Engineers, after being discontinued for the last few years, was revived on the evening of April 13, 1923. It was held in the Smoking Room, instead of the Assembly Room. The affair was an exceedingly pleasant one, and was honored by the presence of several members of the faculty and their wives.

April 17th brought with it a very interesting lecture by Mr. Philip George Lang, Jr., Class of '05. Mr. Lang is at present Engineer of Bridges with the Baltimore & Ohio Railroad and he spoke on the erection of the B. & O. R. R. bridge crossing the Allegheny River at Pittsburgh, Pa., and also on the Belt Coal Pier at Curtiss Bay, Maryland. The lecture consisted in part of a moving-picture study of the actual structures, which were designed by Mr. Lang.

Engineering News

BIGGEST TESTING MACHINE IN THE WORLD AT BUREAU OF STANDARDS

A crushing force equal to the weight of fifty loaded coal cars of a hundred tons each can be exerted by the largest testing machine in the world which is now being installed at the Bureau of Standards. This machine has been in use for several years at the branch laboratory in Pittsburgh and has recently been moved to the main laboratory in Chevy Chase, a suburb of Washington, D. C.

The machine has been erected and when adjusted will be ready about the first of the year to continue work on the specimens for the towers of the Delaware River Bridge now under construction at Philadelphia. After that it will be used on the remainder of seventy-two steel columns which are being tested at Pittsburgh. It has recently been used for tests on forty-five samples of brick walls laid in different ways and with different kinds of mortar.

This machine has two massive heads, one set in a concrete foundation beneath the laboratory floor, the other supported on four steel screws, each over a foot in diameter, and two stories high. The upper head may be set at any height by turning the nuts on the screws by means of an electric motor.

The specimen to be tested is placed in the machine by an electric crane capable of lifting twenty tons. The upper head is brought down until it rests on the specimen and the load applied by a huge hydraulic jack built into the lower head. The piston of this jack, on which the specimen rests, is lifted by oil forced into the cylinder under a pressure of 5,000 pounds per square inch by a motor-driven pump.

Measurements are usually made of the shortening of the column under load, and when it crushes the broken pieces are studied to find the reasons for the failure and the method for making stronger columns.

Long columns are the most difficult of all engineering structures to design. No reliable means has yet been worked out for calculating their strength in advance from the unit strength of the material. This can be done with a rod in tension. Ten ropes will carry ten times as much as one rope, and a bar of iron two inches by five will carry ten times as much load in tension as a bar one inch square—provided the material is the same throughout. But with a column in compression this is not true. The strength depends much more on the shape and size of the part than it does on the amount of material in it, so the only way to be sure the column is strong enough is to test the full sized part in a testing machine such as this.

Pilotless Plane. A pilotless airplane, equipped with an automatic control device said to be more accurate and dependable than any human pilot, has been developed to a point where it has made successful flights of more than ninety miles, the Army Air Service announces.

In actual work with these automatic pilots, hundreds of automatic take offs and a number of automatic flights of ninety miles and more have been made. This "pilot" is capable of being mounted in any type airplane, and in bumpy weather will hold a plane much steadier than a human pilot and will carry it on an absolutely true course, regardless of fog or adverse weather conditions.

Of the automatic pilots being experimented with by the Army Air Service, that which has proved most successful to date can be described as using a gyroscope for its brains and bellows or pneumatics, similar to those used in player pianos, for its muscles.

It was said the invention would have two new methods of bombing; one official asserting it would be entirely practical to load a plane with explosives that would discharge on contact with any target on land or water with great destructive effect. Other military usages, it was predicted, would be discovered as the experiments continued.

—*Aviation, Vol. XIV, No. 1.*

Award of Edison Medal of 1922. The Edison Medal for the year 1922 has been awarded by the Edison Medal Committee of the American Institute of Electrical Engineers to Dr. Robert A. Millikan of Pasadena, California, "for his experimental work in electrical science."

ELIMINATION OF VIBRATION in small rotating machinery is said to be the achievement of Richard Soderberg, Mathematical expert of the Westinghouse Electric and Manufacturing Company, His principle has already been tested out in connection with small electric motors, with the result that, when the motors are held in the hand, no vibration can be felt.

In railway work especially the effects of vibration are very noticeable. The elimination of vibration in this connection would permit of faster and more certain service than can possibly be obtained at present.

THE N. A. C. A. COMPRESSED AIR WIND TUNNEL. The National Advisory Committee for Aeronautics has completed its new compressed air wind tunnel. Its main characteristics are as follows: A five-foot diameter wind tunnel of the usual type, enclosed within a steel tank fifteen feet in diameter by thirty-four feet in length. The cylinder can sustain an internal pressure of four hundred and fifty pounds per square inch, though for all practical purposes the usual pressure will be around three hundred pounds. The usual appliances are used for lighting recording instruments for the model placed in the test chamber.

Provision is made for setting wing angles from without the cylinder. The air is compressed by two three hundred horse power compound compressors, into a receiving chamber at a one hundred and fifteen pound pressure per square inch. Then it is again compressed by a one hundred and seventy-five horse power duplex booster compressor to the desired three hundred pounds in the test chamber. The wind tunnel motor is a three hundred horse power and the Reynolds number is controlled by changing the air density rather than changing the air speed. Provision has been made to avoid opening the chamber until the model is completely tested.

The utility of the old type wind tunnel was limited by the fact that owing to a "scale effect" the results on tests on small models were not immediately applicable to a full-sized machine.

To obtain results strictly proportional to those obtained in free flight, the pressure had to be increased to about twenty atmospheres or more to compensate for the difference in the "scale" or Reynolds number for the model and for the full-sized airplane.

This remarkable device was designed by Dr. Max Munk, technical assistant to the National Advisory Committee for Aeronautics.

CRACKING OF ENAMELED WARE. The Bureau of Standards recently conducted tests to determine the causes of the cracking of enamel on enameled ware and has found that the cracking occurs when the rates of expansion of the enamel and metal differ. The rate of expansion of enamel depends upon its composition and can be adjusted quite accurately to fit that of the metal. The Bureau of Standards has collected a great deal of information on this subject and expects shortly to publish a bulletin giving the compositions of enamel which may be used to the best advantage.

—*Power.*

SYNTHETIC CAST IRON. The problem of determining the best conditions for the production of cast iron by melting scrap steel in the electric furnace has been solved by recent experiments with laboratory furnace. This condition as determined was applied with excellent results. Low grade miscellaneous steel scrap was melted and carburized in a three thousand pound direct arc, three-phase electric furnace and the resultant metal discharged into the molds for the miscellaneous gray iron castings. The carbon and silicon content of the product was under control at all times and the furnace operator had no difficulty in producing the grade of iron required. Satisfactory castings were made with the normal consumption of power and electrodes.

EXPERIMENTS ON KEROSENES. According to a report by Dr. J. H. James, head of the research laboratories of Carnegie Institute of Technology, who is conducting experiments to determine the relative efficiency of kerosenes and oxidized kerosenes as fuels, oxidized kerosenes cause less "knocking" tendencies than straight kerosene when used in kerosene engines. The tests also showed that oxidized kerosenes have approximately the same power development as ordinary kerosene, in spite of the fact that their thermal value is one-eighth less. The efficiency of oxidized kerosenes is attributed to better "clean up" in the combustion of these partially oxidized fuels. The success of the experimental work at this stage gives promise that oxidized kerosene, which is manufactured by catalytic oxidation of low grade petroleum, may become a useful fuel in the future.

Professor Daniel C. Comstock and Professor Herbert D. Kalmus, who worked seven years to perfect "Technicolor," the natural color process from motion pictures, have a factory and laboratories in Boston, where they are now working night and day completing plans to produce Technicolor film on such a scale that it will be available to every motion picture producer in the country.

OIL SHALE is to replace petroleum as the source of the mineral oil supply of the United States according to the United States Bureau of Mines. The most important deposits of oil shale in this country occur in Colorado, Nevada, Utah and Wyoming, but there are many deposits of black shale in some of the Eastern States, including Kentucky, Indiana, and Ohio.

The fact that oil shales produce only about forty-two gallons of oil per ton means that to meet the present requirements of the oil industry there would have to be nearly 1,100 shale retorting plants, each able to put through 1,000 tons of shale a day. Thus it will be seen that to supply the 400,000,000 barrels of petroleum produced annually in the United States from shale, would require the mining of 400,000,000 tons of the material, which is very nearly the present volume of coal production in this country.

Bureau experts have estimated that, to start the industry in sufficient bulk to make it one of commercial importance, it would be necessary to invest approximately $3,000 per barrel of shale oil daily capacity in each retorting and refining plant.

Thus the amazing sum of $3,000,000,000 would be needed in the construction of retorts and refineries alone. This does not include the cost of lands, the opening of mines, or the development of subsidiary industries, without which, a shale oil industry, as such, could exist. Oil shale is a compact laminated rock of sedimentary origin, which is about 33 per cent. ash, and contains organic matter which yields oil when distilled.

Although this oil is not in amounts which are appreciable when extracted with ordinary solvents for oil, the industry has been successful in various countries, prominent among which is Scotland where the investment is more then $12,500,000.

The earliest record of production of shale oil was in Shropshire, England, where "Oyle from a kind of stone" was distilled.

John Palmer Gavit, who probably has more personal knowledge about different American colleges than any other man, says that the students in most colleges can be divided into four groups, as follows:

Group 1—The socially prominent and personally popular. Prominent in athletic and other undergraduate activities. Financially comfortable as a rule with small proportion working their way. Few of high standing in scholarship. Few Phi Beta Kappas and execssive proportion of low-grade students. About 25% of total students in this group.

Group 2—Men of lesser prominence. Engaged in minor sports and activities. Better grades than group 1. Members of less prominent clubs and fraternities. A large proportion working their way. Few Phi Beta Kappas. About 30% of total students in this group.

Group 3—The real students. Not conspicuous socially but monopolizing the Phi Beta Kappa group. About one-fifth of this group working their way and having a hard time financially. Have no time or money to waste and take college very seriously. About 20% of total students in this group.

Group 4—The recluses and entirely obscure. Half or more are earning their way and in serious financial straits. Includes those living in nooks, corners and attics of the neighborhood and getting education under the greatest handicap. Various scholarship grades from highest to lowest. About 25% of total students.

Under the direction of the Engineering Association a series of three lectures have been arranged. The first one is, "Oxygen, the Wonder Worker," the second, "Caribou Power Development," and the third on "Bridges by Ralph Mojeski." The last two will be given on Fridays, the 4th and 11th, respectively. The interest manifested at the first lecture predicts the success of the coming ones.

Logs and Logging

C. C. Roth, '23

ALTHOUGH to the casual observer lumber seems to be plentiful, and a famine in wood something which needs no worry, yet anyone connected with the lumber industry will readily say that wood scarcity is not approaching but actually here. The surest indication of the scarcity of an article is price and if we inquire into the value of lumber, a rapid and continuous rise will be noticed. Substitutes are becoming more and more plentiful, another indication of the rarity of wood. With all of this lumbering goes continually on, whole communities moving from place to place as the forests disappear.

Forest land is now generally owned in two ways, either in small plots by private owners such as farmers or in huge tracts by large corporations. It is quite common for the ordinary farmer to sell his logs "on the stump"; this saves him considerable work and worry; nevertheless the workmen, of the one who buys the lumber, care very little for the surrounding young timber and consequently much more is destroyed than is necessary. Some farmers prefer to cut their timber and sell at the mills, but the mill owners frequently reduce their prices, preferring to buy their material in large lots rather than in small lots from the farmer. In some cases a number of farmers co-operate and run a small mill of their own. They cut considerable timber and allow this to season, it is then sold to a wholesale dealer. However, in the great remote forest districts the work is carried on by a large number of men, directed by a man specially trained in this work.

The sawmill must of necessity be located at such a point which insures both an outlet for finished material and a favourable place for the transportation of raw material to it. A small amount of logging soon necessitates the carrying of material a long distance from the point where it is actually cut to the mill. The manner of supplying the mill with this raw material varies with the locality. In Pennsylvania and in sections of a similiar topography it is the general custom to float the logs down to the mill. This necessitates the mill being located on the bank of a stream which is generally the case. However, before the logs can be floated down, much preliminary work must be done. Camps are erected at the locality selected, roads and railways are built. The large number of men employed, necessitates that sanitary conditions prevail. The men are then organized for the work, being divided into sections and the sections subdivided into gangs, each with a specialized piece of work to do. One gang may fell the trees, another cut the felled logs, and still another strip the main trunk of its branches. More men drag the logs to the roads, here they are placed on sleighs and hauled to a cleared landing on the bank of a stream. This work is done in the winter and in the spring the "driving" begins. The logs are pushed out into the stream, or the rising of the stream washes the logs away; in either case they are then guided their entire course until they reach the mill. In some cases the stream is not sufficiently large to supply enough water to carry the logs and dams must be built up-stream to insure adequate water at the proper time.

If this plan is not feasible, either because of the lack of a stream or because the stream is too small and crooked, the logs are hauled on wagons or small-gauge railways. The latter plan is extensively used and is a safe, quick way to transport logs. Although the number transported is not as large as with a stream, the logs do not lie around and are carried at once to the mill. In the western part of the United States it has seemed most economical to transport logs to the Pacific shore, there mill them and at once ship them. The fact that the mountains here so closely overhang the shore has made it possible to shoot the logs to the mills. Huge slides are built on the mountain sides and down these the logs are shot out into a small bay. The mill is located on its bank and in this way has a cheap and quick means of transporting raw material.

In driving and shooting logs a means must be supplied to raise the logs from the level of the water to that of the mill. This is done by means of a continuous belt, studded so that it will hold a log once placed upon it. This belt extends beneath the surface of the water and as the logs are selected they are pushed upon it by means of long poles. The belt takes hold and carries the logs up into the mill. On the entrance of the log into the mill it is placed upon a moving platform, securely clamped into place, and is then ready to be sawed up into lumber. Two kinds of saws are used, the circular saw and the band saw. Up until just recently, the circular saws were used exclusively but circular saws of a diameter such as was required, necessitated an abnormal thickness, which in turn caused a great loss in lumber. This fact led to the introduction of band saws, which are not excessively thick, do not heat up so rapidly and cut any size of log.

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HOW TO SUCCEED IN BUSINESS

(*Continued from page 9*)

you do well because of the influence back of you, then you have got to do twice as well as otherwise. If you are going into any manufacturing establishment, don't go there by reason of any influence you may have. Start upon your own merits, and start in some lowly position, no matter what it is. Be a laborer, if you will. I don't know but that is the best way to start.

This great war has taught us many things. The one thing it has taught us above everything else is that the true life is the life of modern democracy and simplicity, that it is not one of show or extravagance, that we are men because we are men and because we have the true instincts of man, and we are not men because we are rich or because we occupy a high social position or because we have influence.

Go at your work. You may not find yourself the first year. You may start at work that you think will not be agreeable to you. Do not hesitate to change. If you find that it is not according to your tastes and ultimate ambitions, then change and go into something that is more pleasant. No man can be successful at work if he doesn't find the work he has to do pleasant. No man can ever do a thing well that he is not interested in. When you start in life, if you find you are wrongly placed don't hesitate to change, but don't change because troubles come up and difficulties arise. You must meet and overcome and conquer them. And in meeting and overcoming and conquering them you will make yourself stronger for the future.

Then go on and select your work. Let us suppose you become a craneman. Suppose you become a clerk in a lawyer's office. Give the best that is in you. Let nothing stand in the way of your going on.

Opportunities must come naturally, and the only way that they can come naturally is to give your whole heart, give your whole soul, give your every thought, give your every act to the accomplishment of what you are going to undertake. If you will but make up your mind and determination to go through with what you undertake, you will do that which will bring you more genuine pleasure, satisfaction, and comfort in life than anything else you will ever do.

IMPORTANCE OF COLLOID CHEMISTRY TO INDUSTRY

(*Continued from page 17*)

obnoxious sulfur compounds from crude petroleum, thus suggesting the possibility of dispensing with the costly sulfuric acid treatment in refining petroleum.

The power of silica gel to adsorb sulfur dioxide and the oxides of nitrogen suggests its use in connection with the Gay-Lussac tower of a sulfuric acid plant.

The use of fuller's earth in oil refining is an application of adsorption, as is the use of bone char in decolorizing the syrups in sugar refining.

The physical condition of the soil—its colloid content—has everything to do with its power to retain water—to hold, and adsorb the fertilizing salts so vital to plant growth.

According to W. B. Hardy, a good lubricating film must be powerfully adsorbed by the bearing surfaces. Otherwise the film will tear away in spots and seizure of the metal surfaces may result. It is an interesting fact that Southcombe and Wells found the addition of 1% of the free fatty acids of rape oil, for example, to a petroleum lubricant added as much to the effective lubrication as addition of more then 10% of neutral rape oil itself. This must mean a superior lowering of the interfacial tension between oil and metal. Of course a very low interfacial tension is necessary to film formation and penetration to all parts of the lubricated surfaces.

Many wheats (as California wheat, for exampl)e yield weak gluten flours. Such gluten in the bread dough does not stretch well enough for a good loaf, and admixture with a strong gluten flour is necessary. The protein of corn, rye, and other grains is "weak" in the sense that it does not permit the manufacture of a satisfactory light, porous loaf. The colloid chemist who can so change the physical condition of corn or rye or oat protein that it will stretch like the best wheat gluten will add untold wealth to the world and have much to do with checking famines.

(*Continued on page 28*)

IMPORTANCE OF COLLOID CHEMISTRY TO INDUSTRY

(*Continued from page 26*)

The de-inking of old newspapers is a conservation measure of first importance. S. D. Wells reports that this may be done successfully and the pulp worked over into paper. It is easy to loosen the carbon by dissolving the varnish with alkali but unfortunately the paper fibers enmesh the loosened carbon. However, by adding to wet pulp some Wyoming bentonite, a highly colloidal "transported, volcanic ash," the carbon will be absorbed by the clay rather than by the paper. This bentonite is so finely divided that a water suspension of it passes through a filter paper even though it carry the carbon with it. Over 7,000 tons of newspaper are printed daily.

Sheppard and Bates have invented a process for peptizing (subdividing colloidal size of particle) powdered coal in fuel oil. The coal, even the worst grades, is pulverized until 95% will go through a 100 mesh sieve and 85% through a 200 mesh sieve. Stirred with fuel oil carrying less than 1% of the peptizing agent, a remarkably stable liquid suspension is obtained. As much as 40% of it may be coal and yet it is so fluid that it can be sprayed like fuel oil and burned under boilers. This "colloidal fuel" would be excellent for ships, partly

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IMPORTANCE OF COLLOID CHEMISTRY TO INDUSTRY

(*Continued from page 28*)

because the fire hazard is less than that of oil. As the fuel is heavier than water a sprayed liquid is so good that the lowest coals, even lignite, can be utilized.

All glues are hydrated colloids; hence, when dry they tend to take up water from moist air and thus weaken. So to change these glues so that they will not rehydrate after drying and yet will retain their adhesive power is a problem of vast importance. Large timbers are becoming scarcer and we are being forced to the use of timbers built up from smaller pieces. Present-day glues greatly limit the period of usefulness of glued woods; they weaken too soon.

Metals and alloys at a certain stage of their existence are in a colloidal state, and, although this stage may be brief, a portion of the metal or alloy tends to remain in the colloidal state and exert a powerful influence upon the physical properties of the final solid mass. (Alexander.)

These few applications of colloid chemistry may serve as an incentive to further reading. For such reading I urge the purchase (at a small price, fortunately) of the "First, Second, and Third Reports on Colloid Chemistry and its General and Industrial Applications." These are issued by the British Association for the Advancement of Science. A fourth report is in press and a fifth in preparation.

LOGS AND LOGGING

(*Continued from page 23*)

After being cut the lumber is piled and left to dry or taken to the kiln and kiln dried. The latter is more universally used. Lumber mills have increased enormously in size from the small water power mills to the great mills, now scheduled to cut 1,000,000 feet of lumber per day. Mills of this type are driven entirely by electricity.

By these processes the greatest natural resource of the United States is being rapidly used and little or no attempt has been made to replace it. Recently foresters have been appointed to care for young growth and lumber companies have come to realize that to plant young trees, in place of the old ones just removed, is a wise and profitable practice. However, this is a comparatively recent thought and almost too late as the demolition of our forests is almost complete.

SOME OF MY EXPERIENCES IN GERMANY DURING THE WAR

(*Continued from page 10*)

the drydock. This has always appealed to me as one of the freak situations brought about by a war which was provoked and planned by cabinets and not precipitated by national issues.

At first it was astonishing and then also amusing to me to see why it was that the German people never, even in occasional fanatical outbursts of patriotism evidenced any hatred of America; on the contrary—they "pitied" us. We were supposed to be the dupes of England and France. Germany to this very day does not understand why we entered the war, nor is it fully realized by the general public that we were the decisive factor in the victory of the Allies. France is the national enemy and whatever there is to blame is loaded onto the shoulders of France while England is regarded with dislike and distrust. Such at least were the impressions that forced themselves upon my mind as day by day I came in contact with the people of my limited sphere.

How limited this sphere really was will be better understood when I add that we as aliens, though given much liberty in some respects, were not allowed to travel a distance of more than ten miles from our place of residence without a special permit from the police. Though inconvenient, it does not sound unreasonable. But—and here lay the extreme hardship of the regulation—in order to get such a permit an application had to be filed for from 4-6 weeks in advance to insure its receipt before a certain date.

The police and civil authorities treated us civilly but being left in the care of another nation as far as our interests as citizens were concerned was the hardest of all; little help and no sympathy did we receive from them. We expected nothing from a country with whom we were at war but we did expect more from those who were supposed to be our friends. It was indeed a happy day when I heard that Mr. Stewart, who had been our vice-consul in Hamburg before the war, had returned as representative of the American Commissioner in Berlin and I hurried from one end of the city to the other to speak to him, the first American from "home" that I had seen since the declaration of the war.

It was but a little later that, having finally secured all necessary papers to travel in a world just beginning to awake to the fact that the war itself had come to an end, I together with my sister and brother left Germany to return to "God's own country". It was a lovely afternoon in June when the tug carried us over to our ship lying at her pier in a farther section of the harbor. Just as she came in sight the setting sun touched the flag, our flag. There we stood, all three, watching our flag rising higher and higher till it reached the top of the mast, the top of the world to us, and nobody who has not experienced as we did what it means to live "without a flag over our head" will understand the reverence with which we looked up to the Star-Spangled Banner.

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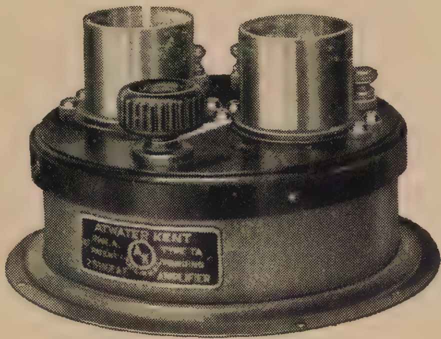

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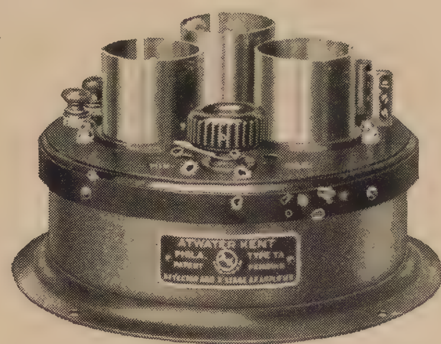

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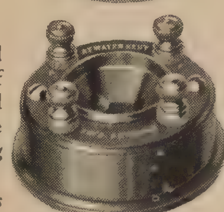

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DAVY EXPERIMENTING WITH GARNETT IN THE ROYAL SOCIETY

The First Electrochemist

NITROUS oxide, according to the science of a century ago, was "the principle of contagion when respired by animals in the minutest quantities." Mere say-so.

Imaginative yet skeptical Humphrey Davy, who believed in experiment rather than in opinion, "respired" it and lived.

It was this restless desire to test beliefs that made him one of the founders of modern science. Electricity was a new force a century ago. Davy used it to decompose potash, soda, and lime into potassium, sodium, and calcium, thus laying the foundations of electrochemistry. With a battery of two thousand plates he produced the first electric arc—harbinger of modern electric illumination and of the electric furnace.

Czar Alexander I and Napoleon met on a raft to sign the Treaty of Tilsit while Davy was revealing the effects of electricity on matter. "What is Europe?" said Alexander. "*We* are Europe."

The treaty was at that time an important political event, framed by two selfish monarchs for the sole purpose of furthering their personal interests. Contrast with it the unselfish efforts of Sir Humphrey Davy. His brilliant work has resulted in scores of practical applications of electrolysis in industry and a wealth of chemical knowledge that benefit not himself but the entire world.

In the Research Laboratories of the General Electric Company, for instance, much has been done to improve the electric furnace (a development of Davy's arc) and new compounds have been electrochemically produced, which make it easier to cast high-conductivity copper, to manufacture special tool steels, and to produce carbides for better arc lamps.

General Electric Company

General Office *Schenectady, N.Y.*

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